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SCIENTIFIC AMERICAN

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OPERATING FOUR POWERFUL WIRELESS STATIONS FROM WASHINGTON, D. C.—[See page 370]

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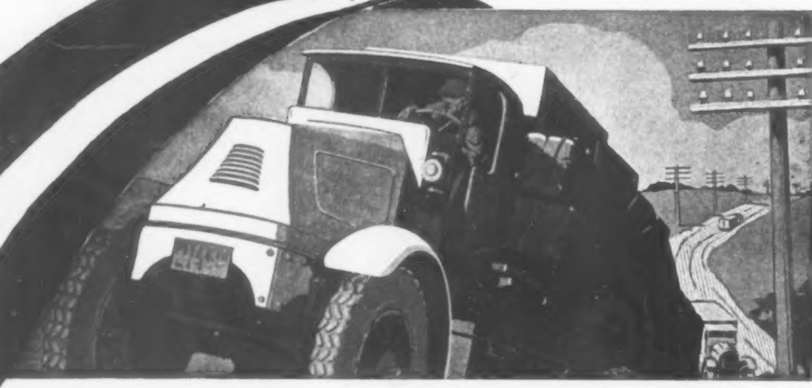

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SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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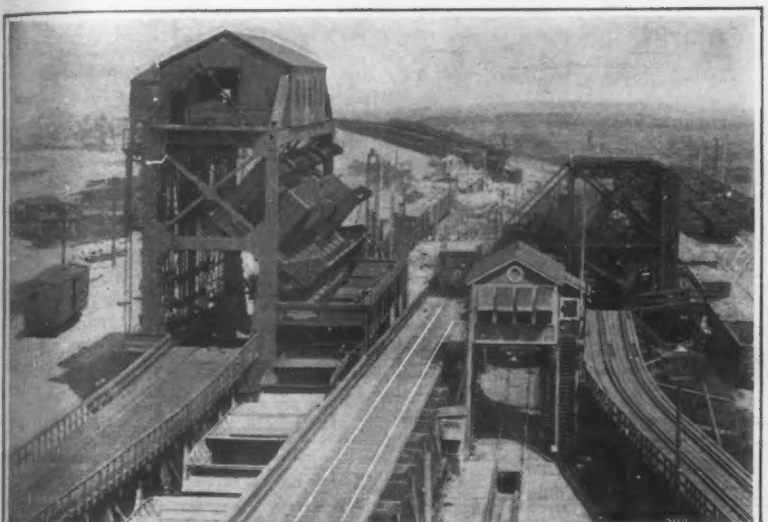
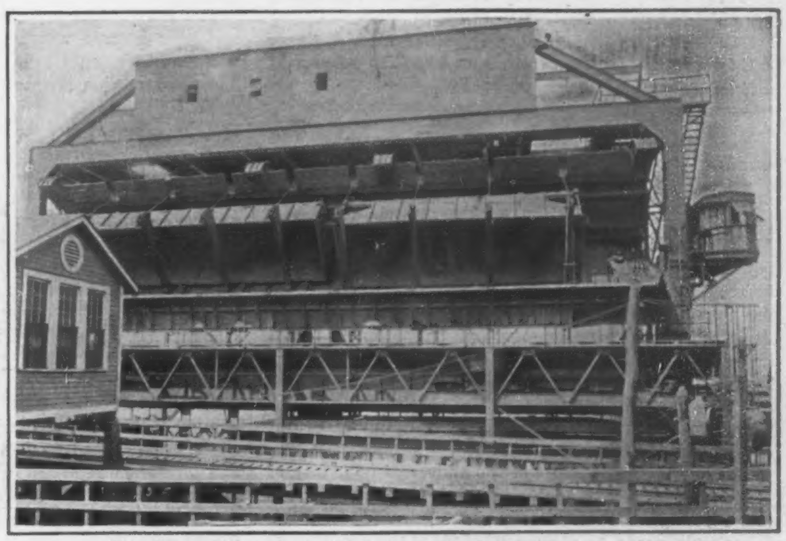


General view of the elevator and two-car dumper at Sewell's Point, Va.



The dumper in action, with two cars in the overturned position

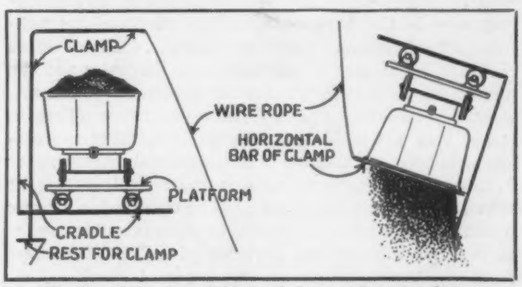
The Biggest Car Dumper in the World

THE United States is the land of big car dumpers. Our medium-sized coal cars haul 45, 50 and 60 short tons of coal; the giants used to a greater or less extent on the Norfolk & Western Railway in hauling coal from the Alleghenies to tidewater at Hampton Roads have a capacity of 100 tons. Naturally, then, the dumper must correspond. But the Virginian Railway at Sewell's Point, Hampton Roads, Va., has recently installed a dumper to handle 120 tons at a trip, without having been forced to this step by any increase of railroad coal cars to a corresponding load capacity.

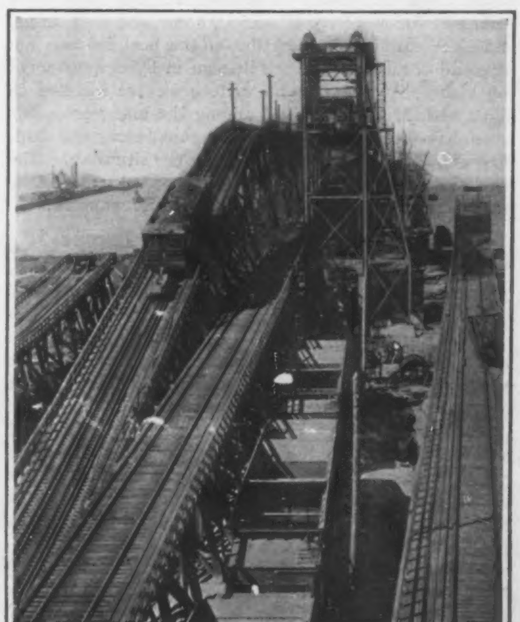
The new installation handles two 60-ton cars simultaneously. Two loaded cars, standing end to end, are overturned sidewise and their contents dumped. American dumpers always operate by overturning the cars sidewise, thus differing from standard British machines. These latter tip the cars endwise. This necessitates an end-gate on the car to permit the discharge of the coal. The English tip about 70 degrees, which is an advantage, and are often able to accomplish tipping with skeleton equipment very simply operated. However, compared with the American giants, their cars are for the most part almost toys.

At Sewell's Point there are some millions of tons to be handled per year, so that high capacity is of the utmost importance. In about two minutes, the new dumper goes through its cycle of operations and dumps its 120 tons.

One of the most interesting things about a car dumper —the most interesting, perhaps, next to the method of overturning—is the little cable car called a "mule," a "barney," "a ground-hog." Modern American car dumpers are, as a rule, elevated more or less above the general level. This is done purposely with the object in view of shortening the vertical lift. The effect is to reduce the period required for the dumper to go through its cycle of operations, and thus increase the capacity of the dumper to overturn and discharge coal. There is a longer or shorter inclined approach to the site of the dumper, over which the mule pushes the one or more loaded cars which it is bringing to the cradle of the dumper. It runs on its own track, located between the rails of the standard track. At the bottom of the approach, its track drops to enable the mule to get underneath the car or cars which it is to bring. It is thus able to get back of the car and into position to shove it up the incline. Under



First and final positions of the carriage and car



Incline to dumping platform, showing transfer car

some conditions, it has been found desirable not to depend upon gravity to return the mule from the top of the incline, but to attach the "tail" of the cable to it and return it by power.

The regulation method of overturning cars sidewise in an American dumper is to run the loaded car out on the platform of an L-shaped cradle, and after hoisting the whole to the desired level, to overturn both car and cradle. The L turns on an axis parallel to the junction line of the horizontal and the vertical parts of the cradle, this axis being so placed that the horizontal arm rises in turning. The rotary movement continues until an obtuse angle has been traversed. At Sewell's Point and other comparatively recent dumpers, the maximum angle runs up to 160 degrees. This means that the car is overturned until its bottom is within 20 degrees of being horizontal again with its top and under sides reversed. The incline over which the last of the coal runs down the overturned side of the car is 70 degrees from the horizontal —just about the British angle of tipping already mentioned. The additional 90 degrees of rotation is the price we pay for the advantage of eliminating the end-door.

The new dumper at Hampton Roads has a cradle long enough to receive two cars. In addition to taking care of the great length, it is also necessary to provide for marked differences in the body widths of the two cars by dividing the platform into two sections. Cars coming upon the cradle must have a clearance space between one side and the vertical part of the cradle. With broad cars, the space would be at a minimum, and with narrow ones at a maximum. As the overturn begins, the load on the short length of rails in the cradle begins to diminish and weight commences to come upon the normally vertical part of the L. This transfer continues until 90 degrees of rotation have been completed, at which moment the car will rest entirely on its side, against the normally vertical side of the cradle. In order to avoid the shock consequent upon a sudden shift of the loaded car at the beginning of the overturn, it is customary to arrange the short length of rails on a movable platform. This platform rests on wheels, or their equivalent, and these are carried by the cradle proper, the platform shifting transversely to the track. Now, in the case of the two-car dumper, there would be, with cars of markedly different widths of body, two distinct lengths of horizontal shift needed to get the two cars ready to

(Continued on page 382)

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

American Ship-Operating Program

THE operation of a large merchant marine is complicated and difficult to a degree that is only understood by those who are engaged in it; and Mr. Hurley is to be congratulated upon the clarity with which he handled this problem in his recent address before the National Marine League in this city. In a previous address on the question of our shipping, he dealt with our great constructional program—what it had done and what it proposed to do. In this address—for the first time—he gave an outline of his proposed plan for the ownership and operation of the vessels built for the Government by the United States Shipping Board, of which he is Chairman.

The outstanding feature of the address, to our way of thinking, was his candid admission that he was unalterably opposed to government ownership. In unmistakable words, he announced that, as the result of his own experience, both in private business before the war and since he has held his high position in the councils of the Government, he was convinced that only by the sale of the ships to private owners and their operation by private interests would it be possible to secure that combination of energy and initiative which are necessary in all business enterprises, and nowhere more so than in the matter of the operation of a great merchant fleet. At the same time, he would have the fleet operated in close association with the Government, both in respect of advice and of financial support. He aims to prevent the passing of the fleet under the control of a few great companies, by framing the terms of purchase and governmental operation so that watering of stock would be prevented and the field would be kept open to the small operator, whose opportunity to compete with the large operator would be protected by the Government.

At the present time, the United States Government owns 555 ocean-going steel cargo ships, aggregating 3,385,475 dead weight tons. In addition, it has under contract 1,336 similar vessels of 9,275,006 dead weight tons. If our present program be carried out, there will be under the American flag next year 16,732,700 dead weight tons (11,155,000 gross tons) of ocean-going steel cargo and passenger ships. Of this total, the Government will own about 70 per cent or, say, 11,712,890 dead weight tons (7,809,000 gross tons), and the nation must at once determine what use it proposes to make of this great national asset.

Many are the plans which have been considered, and they range between straight government ownership and operation, on the one hand, and unregulated private ownership and operation on the other. In their order, as given by Mr. Hurley, they are, first, government ownership and operation; second, government ownership and operation for the benefit of the Government through the medium of a private corporation; third, government ownership and private operation for government account; fourth, government ownership and private operation for private account; fifth, ownership by a single private corporation; and lastly, private ownership and operation, in which the vessels would be sold to private companies, to be operated by them entirely for their own account, the Government thus relinquishing all interest and control.

Mr. Hurley's recommendations are that the ships should be sold to and operated by American citizens under no restrictions other than the terms of the bill of sale and the fixation of maximum freight rates; and he considers the ships should be sold at a price which fairly reflects the current world market for similar tonnage.

Under this arrangement, 25 per cent of the purchase price of each ship would be paid down at the date of purchase, the remainder falling due and payable in graded annual instalments extending over a period not exceeding ten years. The Government would take a mortgage for the unpaid balance, charging the customary commercial rate of interest of five per cent. One-fifth of this interest, representing the difference between the customary government interest of four per cent and the customary commercial rate, would be paid into a Merchant Marine Development Fund.

The purchaser would be required to agree to insure and keep insured with an American marine insurance company, his equity in the vessel, and because the American marine insurance market has not at present sufficient resources to underwrite all the vessels which the Government has to sell, the Government should carry in its own fund, as at present, but for the purchaser's account, insurance on the hull and machinery covering that part of the vessel for which payment has not been made.

No vessel could be transferred to foreign registry without express permission of the Government, and each purchaser who wished to operate in the foreign trade would be obliged to incorporate under Federal charter. One member of the Board of Directors for each company will be named by the Government; he will receive no salary, but only the customary director's fee for each meeting he attends. Thus, government-named directors would meet periodically in Washington where they would confer with and advise the Shipping Board.

The Merchant Marine Development Fund, representing one-fifth of the interest on the mortgages, would start with $7,650,750 the first year, and the size of the fund for the 10-year period in which the ships would be fully paid for would be $83,533,170. This fund would be used to relieve such financial difficulties as may be encountered in the development of an adequate and well-balanced American merchant marine. Thus, it is realized that a number of trade routes, important to the immediate or future welfare of American commerce, must be established and developed. Some of these routes may not yield operating profits until their existence shall have attracted an increased volume or better balance of trade. Thus, in cases where the Government sells a ship upon condition that it be operated in a route which may not prove profitable at once, it will be necessary to provide for the payment of defaulted interest from this Merchant Marine Development Fund.

Mr. Hurley in conclusion stated that his plan was based upon profound convictions, formed after close personal studies of conditions at home and in Europe, and after careful consideration of the best information he could obtain of what is going on in other quarters of the globe. At the present writing we are inclined to agree with Mr. Hurley that among the many proposals which have been made, this plan, as thus briefly sketched, presents the best promise of meeting the situation. The whole address which is worthy of careful reading, is published in the current issue of the SUPPLEMENT.

Our Special Correspondent in Europe

WITH the publication in the present issue of Mr. Claudy's article on "British Munitions," we bring to a close the series on reconstruction in Europe, so far as it concerns Great Britain. From London, our correspondent went to Paris, and the story of reconstruction in France commences in the next issue and will run through several numbers.

The problem of swinging the whole energies of a great nation around from the activities of war to those of peace is serious in any war, and in a struggle of the magnitude of this war, it is simply stupendous. In the case of stricken France, whose fair lands were for many years the principal arena of the conflict, the task of reconstruction is not only stupendous in magnitude but utterly bewildering in the complexity and infinite variety of the contending claims, each of which calls for quick relief.

In England, where, save for the occasional and limited destruction wrought by the Zeppelin and the airplane, the material damage was relatively negligible, the reconstruction problem, as Mr. Claudy shows, is entirely economic, political and social—it is a mechanical problem of placing war plants on a peace basis, of the construction of delayed buildings, of restoring run-down railways, of rebuilding shattered industries and, above all, of re-adjusting labor conditions.

The French Government must also do these things; but, overshadowing them all, there stares it in the face vast stretches of the fairest lands of France, once teeming with inhabitants and a hive of manufacturing industries, which lie today as barren, desolate, and devoid of inhabitants as the desert of Sahara. The magnitude of the problem which confronts the French, and the methodical way in which they are applying their intelligence and courage to its solution, will be told by our correspondent in the series of articles which will commence in our following issue. This material was gathered from official sources in Paris, and after an exhaustive personal exploration of the stretch of wasted land lying between the North Sea and the city of Verdun.

British and German Gunnery

CONSIDERABLE discussion has been going on in the British press of the respective gunnery results in the British and German navies, particularly at the Battle of Jutland. Critics of the British methods claim that the sinking of three of Beatty's battle-cruisers in rapid succession proves that the German fire was more efficient. An explanation of this superiority is found in the supposition that the German salvos were "bunched," whereas the British were, relatively, scattered, that is to say, the British aimed to get in one hit in every salvo, whereas the Germans expected that some salvos would miss, but that several hits would be made in each salvo that did land.

In explanation of the above it should be stated that no two guns of the same type, or mark, shoot exactly alike. This is due to slight, but apparently unavoidable differences, which serve to scatter the shots from a broadside, say, of a dozen 12-inch guns. Some of the shots will drop over, others short of the target, and the extreme difference may be as much as 1,000 yards at great ranges. To correct this, the guns are "calibrated"—certain corrections are made and the sights adjusted. After a broadside of guns has been calibrated, all the shots should, theoretically, fall on the same spot, though differences in the respective charges of powder may cause some dispersion in spite of calibration.

However, let us suppose the calibration has been well done and that the powder is very uniform. In this case, if the range-finding is correct, and the gun-pointer expert, several shots of a salvo will land on the ship. Good. But if ranging is difficult and the gun-pointer is not quite up to form, the target will be missed altogether and not a shot will go home. Now it is these considerations that have made gunnery officers prefer to have some dispersion in their salvoes; for if the shots are spread out over several hundred yards, the mean point of impact does not have to be exactly on the ship; in other words, although aim may be a little long or short, one or more shots will have a good chance to land.

The British favor—or, at least, they used to favor—having a certain amount of dispersion in their broadsides.

Sir Percy Scott, the father of modern gunnery and particularly of director-firing, once told the writer that when he took over a certain new dreadnought, he did not calibrate the guns closely, believing that he could obtain better target results in this way.

In the earlier stages of every engagement the German gunnery was good; but as soon as the British got "on," there was a rapid falling off in accuracy. This may be explained by the possibilty that the German system of director-firing involved elaborate electrical connections, the breaking of which by landing shells disorganized the whole system. Or was it that German nerves were shaken by the burst of 13.5 and 15-inch shells?

We are inclined to the belief that the comparative immunity of the German battle-cruisers, of which only one was sunk, was due more to superior protection than to better gunnery. The High Seas Fleet was built for service in the North Sea, the Grand Fleet for possible service in far distant waters. Coal capacity and berthing space were sacrificed in the German ships for elaborate subdivision of the hull, heavy side armor and complete armored decks.

Engineering

A New Harbor on the Baltic.—It is reported from Copenhagen that a new harbor is to be constructed at Korsör, which is a Danish seaport 60 miles west-southwest of Copenhagen. The cost of this work is estimated at 30,000,000 kronen and it is stated that American capital has been interested. The harbor will have a depth of ten meters as against nine meters in Copenhagen and large quays will be built with ample facilities for handling merchandise.

Cement Joints for Water Mains.—The Bureau of Water Works of Portland, Ore., has been using cement in place of lead for the joints of its cast-iron water mains. According to the engineer of the Bureau, one pound of cement at half a cent per pound will satisfactorily take the place of three pounds of lead at eight cents per pound, so that there is a material saving in cost. The labor of making the joints, however, reduces this saving because the cement joints have to be kept wet for from 36 to 48 hours. The joint is first packed with yarn and oakum and then neat cement is forced in.

Speeding up the Hardening of Concrete.—The Bureau of Standards recommends the use of a small quantity of calcium chloride in the mixing water of concrete in order to accelerate the hardening of the concrete. Tests conducted by the Bureau show that the addition of calcium chloride up to 10 per cent by weight to the mixing water increases the strength from 30 to 100 per cent over that of concrete in which plain water is used, and that the best results are obtained when from 4 to 6 per cent of calcium chloride is used. While calcium chloride has no deleterious effect upon the concrete, it does affect iron and steel and, therefore, the salt should not be used for reinforced concrete.

How Much Water Should Be Used in Concrete?—The Emergency Fleet Corporation, in connection with its work on concrete vessels, has developed an apparatus for testing the amount of water which should be used in concrete work. An open metal cylinder is employed resting upon a glass plate. This serves as a mold which is filled with concrete and smoothed off level on top. Then the cylinder is raised, leaving the concrete on the glass plate. If the mixture is very dry, the concrete will maintain its cylindrical form, but the wetter the concrete the more it flows out at the bottom, so that a measure of the consistency of the mixture can be obtained by measuring the height of the cylinder or cone of concrete after the metal cylinder has been withdrawn.

Treating Railway Ties with Zinc Chloride.—The American Railway Engineering Association, while admitting that creosote is generally the best preservative for railroad ties, calls attention to the fact that there are certain conditions in which it cannot be used economically, and under such conditions recommends the use of zinc chloride instead. One of the objections to zinc chloride is that where there is excessive rainfall, there is a tendency for the salt to leach out of the wood, but this is not usually very serious and it can be checked to some extent by the use of a lubricating agent. The ties should be seasoned for 60 days after treatment so as to increase their strength and so as to reduce the amount of leaching of the zinc chloride. This also reduces the leakage of current from the rails.

Novel Bridge Engineering.—Not long ago it was discovered that the piers of the combined highway and railroad bridge across the Missouri River at St. Joseph, Mo., were in bad condition and it would be necessary to build new piers. At first it was proposed to build the new piers on the downstream side of the old bridge and shift the bridge laterally to the new position, in this way maintaining traffic over the old bridge while the new construction was going on. But the War Department required the installation of a larger draw-span in the bridge and so it was decided to build the new piers between the old piers. After they were completed, the fixed spans of the bridge were moved shoreward endwise, so that they rested on the new piers. A temporary span was constructed to fill the gap thus occasioned, so that traffic was closed over the bridge for less than ten hours. Then work was begun upon the new swing span, which was built as a cantilever in open position. To permit of this, a portion of the old swing-span had to be cut away and a temporary lift-span was put in to take care of river traffic. Thus the bridge was reconstructed without changing its alinement and with a minimum interruption of traffic.

Science

Tide and Current Observations at Lightships.—The Coast and Geodetic Survey has recently obtained authority from Congress to pay not to exceed $1 a day extra compensation to employees of the Bureau of Lighthouses for making observations of tides and currents. Many lightships are particularly well situated for making such observations, and it is expected that valuable data will be collected.

Indexing Family Traits of Americans.—The Eugenics Record Office, at Cold Spring Harbor, Long Island, is engaged in building up an analytical index of the inborn traits of American families, especially with a view to studying the inheritance of such traits, tracing their recombination in given pedigrees, etc. Down to the beginning of last year the Office had on file 534,625 cards indexing individuals who are described in the archives of the establishment, on the basis of surname, natural trait, and geographical locality. An elaborate classification of traits has been worked out.

Measuring the Temperature of Leaves.—Miss Edith B. Shrefe has devised very sensitive electrical apparatus for measuring the surface temperature of leaves and has been making measurements in the desert and mountains near Tucson, Ariz., and the Santa Lucia Mountains in California. She reports that the most outstanding result of these measurements is the rapidity with which the surface temperature of a leaf growing in the open may fluctuate. Changes of from one to three degrees C. are observed within from 20 to 60 seconds. If a moderately strong wind is blowing the change may amount to five degrees in 30 seconds. Changes in atmospheric conditions are without doubt the cause of these fluctuations.

Radium Production in the United States.—Mr. C. H. Viol, writing in *Science*, states that the total production of radium element in the United States down to 1919 is about 55 grams, which is probably more than half the total radium produced in the world. During the war, with no carnotite exports, the greatest part of the world's radium supply has been produced in this country. In 1918 the United States produced 13.6 grams. With regard to a discussion that has occurred concerning the amount of radium that can be produced from the carnotite fields, Mr. Viol says that the carnotite holdings of the Standard Chemical Company, which comprise about 350 claims and are the largest holdings under the control of a single concern, are estimated to be capable of yielding at least 500 grams of radium.

Zoölogical Station in British Guiana.—The work of the British Guiana Research Station of the New York Zoölogical Society, which was interrupted by the war, has just been resumed, three members of the staff, headed by Director William Beebe, having sailed for South America on February 26th. This is the station which Theodore Roosevelt visited three years ago, and of which he wrote: "The establishment of a tropical research station in British Guiana by the New York Zoölogical Society marks the beginning of a wholly new type of biological work, capable of literally illimitable expansion." The station is situated at Katabo, at the very edge of the jungle and at the junction of two great rivers—the Mazaruni and the Cuyuni. It is now being equipped with the most complete laboratory equipment ever taken to the tropics. A number of eminent American zoölogists will undertake investigations at the station in the course of the present year.

The Dendrograph.—Dr. D. T. MacDougal applies this name to a new instrument devised by the Department of Botanical Research of the Carnegie Institution for recording growth and other variations in the dimensions of trees. Two types of the apparatus are now in use. Both employ a belt of wooden blocks hinged together and fastened securely as a supporting belt around the trunk of a tree. In one type, series of plungers in contact with a number of selected points around the tree carry on their outer ends an encircling wire. Any change in position of the plunger moves the encircling wire and the motion is recorded by a pen on a suitable revolving drum. The second type carries a yoke which encircles the trunk of the tree with four points of contact. Changes in volume of the trunk are followed by differences in distances between the contacts, which are duly recorded as above. These devices furnish an interesting record of the daily and seasonal changes in the size and form of tree trunks.

Industrial Efficiency

Alcohol from Swedish White Moss.—A syndicate has petitioned the Swedish government for permission to make 5,000,000,000 liters (1,321,000 gallons) of alcoholic spirit from white moss, of which there are enormous quantities available. The quality of such alcohol is said to be very good, and its cost less per liter than spirit made from grain or potatoes. It can be easily denatured. The petition proposes that the alcohol be manufactured under official supervision and that the government be taken in as partner.

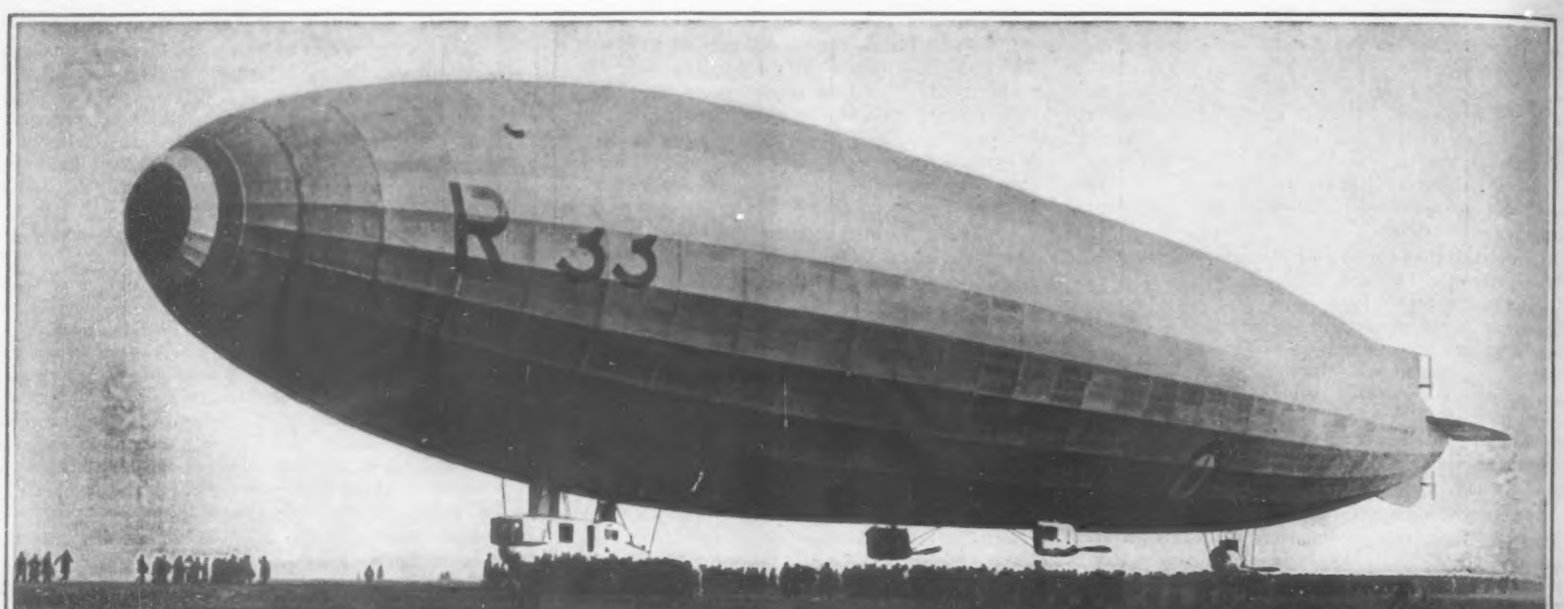
Care with Scaffolds.—During the past year there have been reported to the Bureau a number of accidents which have occurred as a result of scaffolds breaking, collapsing, or falling. While those accidents are not frequent, according to *Safety Bulletin*, they are as a rule of a serious nature. Construction of scaffolds of either unsafe or improper material is only courting a serious injury or death, and great care should be exercised to see that all scaffolds are constructed so that they will safely stand the load which they are expected to bear. Nothing but the very best of materials should be employed.

Fuel Saving.—Through the coöperation of the industrial power plants, which have thus far put into force the standard recommendations of the United States Fuel Administration to promote efficiency in the use of fuel in power plants, a saving of 7,000,000 tons annually has been effected. That is to say, in the first six months from the announcement of the national program, 3,500,000 tons have been conserved, at the same time maintaining maximum production in the factories. The largest savings have been in the following states: Massachusetts, Pennsylvania, Connecticut, Illinois, New York, Missouri, Michigan, Minnesota, and Wisconsin.

Deep-Sea Salvage Equipment.—Owing to the dangerous nature of the coast and the consequent frequent wrecks, salvage work has always been of considerable importance in Spain. This work has been increased by the war, during which many vessels were sunk off the Spanish coast by the U-boats. The large profits from the business, which before the war was largely in German hands, have attracted the attention of capitalists in northern Spain, and an important company has been organized to engage in salvage work. This company is well equipped, but owing to the great extension of its activities, new purchases are constantly being made. There is, therefore, an important market in Spain, particularly in Corunna, for the sale of the latest devices pertaining to this work, and also for machinery for the reduction of the salvaged metals.

Use of Goggles.—A large number of accidents have been reported recently, due to the workmen not wearing the goggles provided by most companies for employees engaged in certain classes of work. It is rather difficult to understand the attitude of many workmen toward goggles, in view of the painful injuries that so often follow failure to wear them. There is no excuse for men not wearing goggles in such work as, for instance, disconnecting steam or acid lines. In a recent case, however, two workmen, taking down an acid line, sustained painful eye injuries due to the acid splashing. It is for the foreman in charge of the work to take greater pains in explaining the use of, and the results of a failure to wear, goggles while engaged in certain classes of work, continues *Safety News*. Goggles are provided for use, and it should be impressed on the minds of workmen that they are to prevent unnecessary and painful accidents.

Suitable Tasks for Disabled Fighters.—An outline of the efforts of the Bureau of Employment of the Pennsylvania Department of Labor and Industry to find suitable industrial tasks in Pennsylvania for disabled soldiers and sailors is given in a bulletin just issued by the Department. This bulletin, which may be obtained upon application to the Department of Labor and Industry, at Harrisburg, analyzes by task and locality, the 50,000 employment opportunities offered by 900 employers in 60 counties, number of plants, kinds of firms, and numbers of openings in each class of employment. One series of tables shows at what tasks several hundreds of disabled men are now employed by the Philadelphia and Reading Railway Company. Another chapter on "Placement of Disabled Soldiers and Sailors in Employment" gives a general review of the placement subject, outlining conditions that may be expected and methods to be employed in locating each disabled soldier and sailor at a specified task in Pennsylvania plants.



Copyright, Underwood & Underwood
The latest rigid dirigible constructed by Great Britain—the R-33—which made its first flight on March 6th last, staying aloft some three hours

Is the Dirigible Outstripping the Airplane?

Recent Progress in Lighter-Than-Air Craft Which Has Brought That Type to the Forefront of Aviation

THERE are all the elements of a good romance in the story of the dirigible. As the first type of airship to be taken up by the nations of the world, the lighter-than-air craft proved quite unsatisfactory. The numerous mishaps to the early dirigibles impressed on the minds of the general public an absolute contempt for that type. They did not stop to consider the crude nature of the dirigible; they did not recall that the steam locomotive, back in 1830, was just as crude, just as inefficient. They simply condemned the dirigible on first impression.

Then came the airplane. There is something fascinating about the airplane, with its delicate structure of fine ribs and fabric and the powerful driving engine and propeller; and the public immediately became attracted to the heavier-than-air craft. Numerous intrepid airmen did all sorts of daring stunts with airplanes, crude as they were in the early days, much to the satisfaction and interest of the laity. And the opening days of the war found the airplane receiving practically all the attention from military authorities, to the more or less complete exclusion of the dirigible—except in Germany.

The layman never could understand how old Count von Zeppelin could continue year after year to build his ungainly dirigibles. Indeed, it seemed that as fast as he turned them out, they met with tragic accidents and an untimely end. Yet the Count continued; and when his money gave out, because of the long series of failures of his earlier Zeppelins, the German government came to his rescue and supplied practically unlimited funds. And again the Count went on, building more Zeppelins than ever; and the more he built the more, so it seemed, were destroyed.

Tail members of dirigible, with lookout post

When the war came on, Germany attempted to employ her vast fleet of Zeppelins—which she had accumulated faster than they could be destroyed under ordinary navigating conditions—with unsuccessful results. Truly, she misjudged the military value of these huge dirigibles; but when she turned them over to the naval authorities, they immediately proved a big success. As super-scouts, nothing could compete with the Zeppelins, which were capable of staying several days out at sea, without coming down for fuel or supplies.

Great Britain, quick to grasp any new idea in naval warfare, soon appreciated the advantages of huge rigid dirigibles. After constructing vast fleets of small non-rigid and semi-rigid dirigibles for anti-U-boat warfare, she turned to the construction of rigid airships with brilliant success. Today, Great Britain has a number of large rigid dirigibles, which in point of detail and performance may prove more than a match for anything Germany has ever constructed, notwithstanding the world-wide belief that Germany is the only country in the world capable of constructing huge dirigibles.

That, in brief, is the romance of the dirigible. It has

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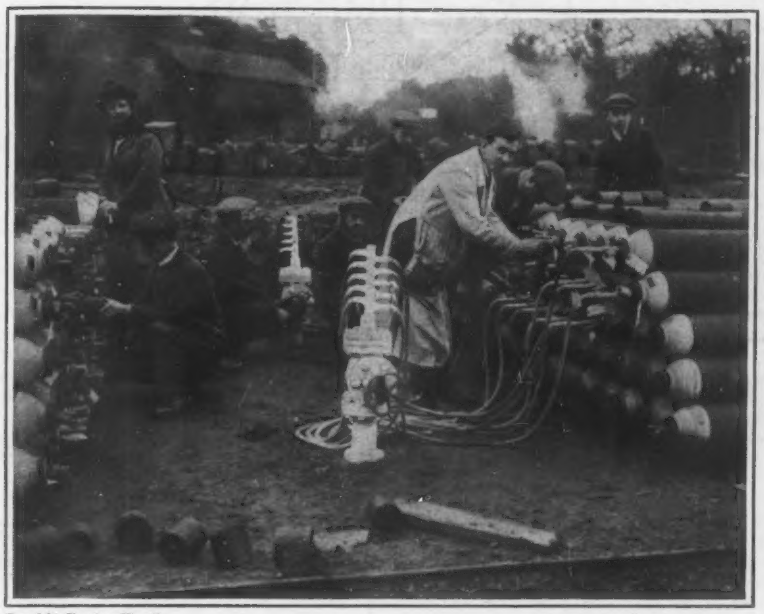
Forward gondola of the R-33, which contains the navigating quarters and a single 250-horse-power engine

Copyright, Keystone View Co.
One of the two "power eggs" located amidships, containing a single 250-horse-power engine

won out despite all obstacles and against the greatest handicap of all—public opinion. Its war record, aside from its misapplication to military warfare, has been splendid. In four and a half years it has shown a greater proportionate development than the airplane, unbelievable as this may sound. And now that commercial aviation is being discussed in a really businesslike tone, the dirigible looms up as the real aerial greyhound of tomorrow, with the airplane as little more than a "feeder" for the dirigible. That is to say, dirigibles will cover the long routes of thousands of miles, where quick transportation really saves much time, while the airplane will serve to bring passengers and carry them away from the dirigible stations located a thousand or more miles apart.

Typical of the immediate possibilities of the dirigible is the latest British rigid airship, the R-33, shown in the accompanying illustrations. This dirigible, which made its trial flight on March 6th last, when it remained aloft some three hours and reached an altitude of 2,000 feet, is 670 feet long and 79 feet in diameter at the thickest point along its splendidly streamlined body. In fact, the R-33 closely follows the lines of the German Schutte-Lanz dirigibles, which are stream-lined instead of pencil-shaped as were the earlier Zeppelins. The nose is round and somewhat tapered, while the stern is tapered to a fine point and carries the êpenage, or tail members. An interesting feature of the tail is the small lookout post, which is shown in one of the accompanying illustrations, and which in the military application of the dirigible is used as a gunner's post. The body of the R-33 is constructed of duralumin girders, covered with fabric, and contains 19 gas bags.



Copyright, Keystone View Co.

Compressed gas cylinders, connecting tubes and valves employed in inflating the 19 gas bags of the R-33

Suspended from the huge body of this British dirigible are four gondolas. The navigating quarters are located in the first gondola, which is placed well forward. Somewhat farther back, or about amidships, are two so-called "touring" gondolas or "power eggs." Finally, there is the large gondola aft. The forward and amidship gondolas are each provided with a 250-horse-power Sunbeam-Maori engine, while the aft gondola carries two similar engines, coupled together and driving one large air screw.

The R-33 carries a crew of 23 men, and is said to have a cruising range of 4,000 miles at 60 miles an hour. It weighs 60 tons, and carries a useful load of 30 tons. In the preliminary tests the speed, so it is reported, has been nearer 50 miles an hour, and it may be that the engines will have to be replaced by more powerful units in order to secure the requisite speed. At any rate, the dirigible appears to be a most commendable piece of work. All conveniences have been provided for the crew, including facilities for cooking and heating food, by means of hot water from the engines and electric stoves. Parachutes are provided for use in the event of accident. The R-33 is one of several dirigibles of similar type which the British are rapidly completing.

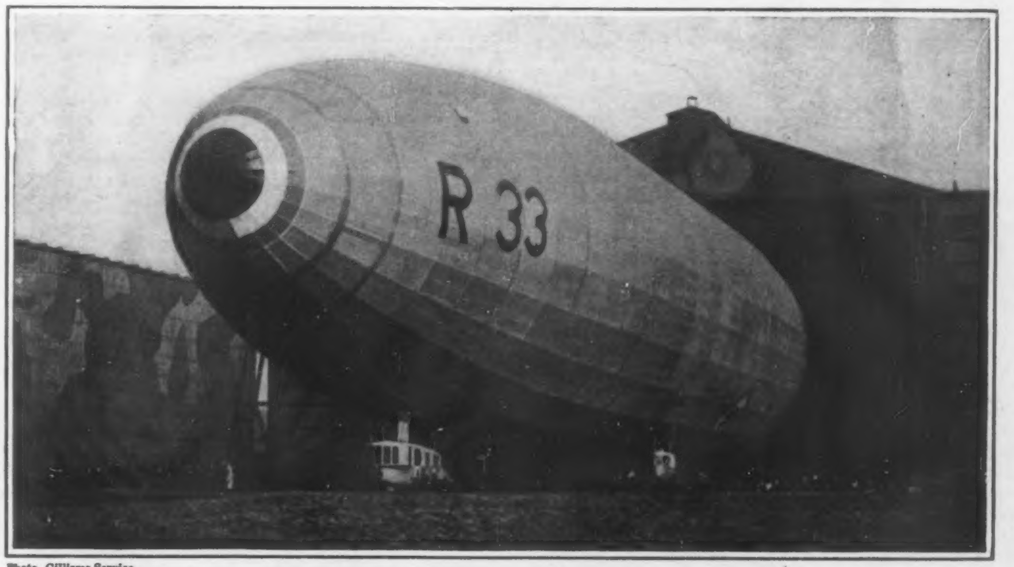


Photo. Gilliams Service

The R-33, Great Britain's largest dirigible, coming out of the huge shed preparatory to the trial flight

Compared with the airplane, which only possesses the advantages of high speed, low cost of production and maintenance, and ease of housing, the dirigible may well claim: long endurance; the ability to carry heavy loads, which is a corollary of long endurance; variation of speed and the ability to "float" or remain aloft while engines or other mechanisms are being inspected or repaired; general reliability, by which is meant maximum freedom from liability to mechanical breakdown during flight; comfort; security, because an airship does not descend in unfavorable country even if the engines totally fail.

Recent improvements have raised the rigid dirigible to a high plane. The substitution of helium for hydrogen, which is one of America's contributions to military aviation, removes one of the greatest prejudices against the lighter-than-air craft. For now that helium gas, which is non-inflammable, is used in place of explosive hydrogen, there is no further need to think of conflagration during flight or on the ground. Engines can be placed anywhere, and so can the galley and stoves and heating plant, since the dirigible is no longer a huge explosive charge held in a silk bag, ready to burst into flames at the slightest spark.

Then there is the matter of landing and mooring. The British have worked out a scheme of mooring dirigibles to a single mast provided with a revolving top. Thus the dirigible can turn in accordance with the wind, and is not subjected to any serious strains. Indeed, a British dirigible has been moored in this manner for five weeks at a time, successfully withstanding winds up to 52 miles an hour, with only two or three men to watch after it.

Frankly, the airplane as a commercial proposition is today but a poor second to the dirigible, except in its own limited field, which is the carrying of a small number of passengers over a short distance of say a few hundred miles, or the transportation of a light cargo, such as films, mail, securities, jewelry, or other items of a high intrinsic value, in instances where great speed is the very quintessence of the journey or route. The airplane is to be the competitor of the fast railroad train, while the dirigible is destined to be the carrier of passengers and goods over long routes, in competition with the transcontinental trains and the intercontinental steamers.

A New Substitute for Tool Steel

ONE of the war-time developments in England due to the acute shortage of tungsten was the manufacture of an alloy steel containing no tungsten to take the place of tungsten high-speed tool steel. This steel, high in chrome and cobalt, is now being used for the manufacture of dies and tools, being offered as a substitute both for carbon and tungsten high-speed tool steel. The steel is made in Sheffield, England, and received here in pig form. The pig metal is melted at the Cleveland plant in a crucible and cast in molds in the form desired. The pattern makers make the same allowances for shrinkage as they do for soft steel. The cast tools are furnished in an annealed form to the customer, who machines them to accurate dimensions, and after hardening they are ready for use.

The alloy is being cast into blanking, drawing and forming dies, hot and cold trimmers for forge work, milling cutters, counter sinks, slotting saws and bending rolls. It is also stated that cast tools made from this alloy are being successfully used as cutting tools on lathes, planers and shapers when working on brass and bronze. The metal produces, it is claimed, a clean casting free from blow holes and other imperfections.

An Odd Automobile Accident

DURING the recent 250-mile road race at Santa Monica, Cal., one of the cars met with an accident at a sharp curve known as "Death Curve." Here a sand-bag barricade had been erected ostensibly for the purpose of keeping the cars within the bounds of the road. The car in question was going so fast that it could not take the curve, but struck the barricade and leaped over the sand bags. Fortunately neither the driver, Roscoe Searles, nor his mechanic was injured. More remarkable than the accident, however, was the fact that a photographer succeeded in snapping a picture of the car as it was in mid-air. He had taken a position at this point expecting to obtain some thrilling pictures and was fortunate enough to make an exposure just as the accident occurred. The picture he took is reproduced herewith. Note the cloud of sand thrown up from the sand bags and also note the telegraph pole which the car grazed as it plunged.

A plunge through the sand-bag barricade at "Death Curve" during the recent 250-mile road race at Santa Monica, California

A New British Port

Proposed Dock in Falmouth Harbor That Could Accommodate 1,000-Foot Liners

By Eric A. Dime

RECENT developments indicate that the next few years will see the launching of many large steamships which may range up to 1,000 feet or more in length. In that event new berths and graving docks must be provided in the most suitable ports.

According to Sir A. Booth of the Cunard Company the purely cargo steamer in the North American trade is passing. He expressed his belief recently that the Atlantic transport trade of the future lies with the 40,000- to 50,000-ton steamer carrying freight, passengers and mail, and if he be right in his belief, the cargo business of the future will necessarily go to the ports where mammoth passenger and cargo steamers can be properly accommodated. Under present conditions our largest steamships are unable to enter or leave Southampton, Liverpool or London except when the tides are favorable on the bars and in the channels. They can only enter Liverpool during twelve hours out of the twenty-four and they can only go into dock there when their time in port more or less coincides with the period of spring tides. There is no port in the United Kingdom possessing suitable dock accommodation which large steamships like the following can enter or leave in all states of tide and weather:

"Brittanic," 50,000 tons, 900 feet; "Aquitania," 50,000 tons, 885 feet; "Olympic," 45,000 tons, 882 feet; "Mauretania," 32,000 tons, 790 feet.

The principal ports of England, the majority of which are approached by long and shallow channels, were more or less convenient for shipping in the past, but the heavy expenditure necessary to adapt them to the requirements of modern shipping makes their continued use uneconomical. They retard the progress of shipbuilding and would handicap British shipowners and merchants in competition with their foreign rivals.

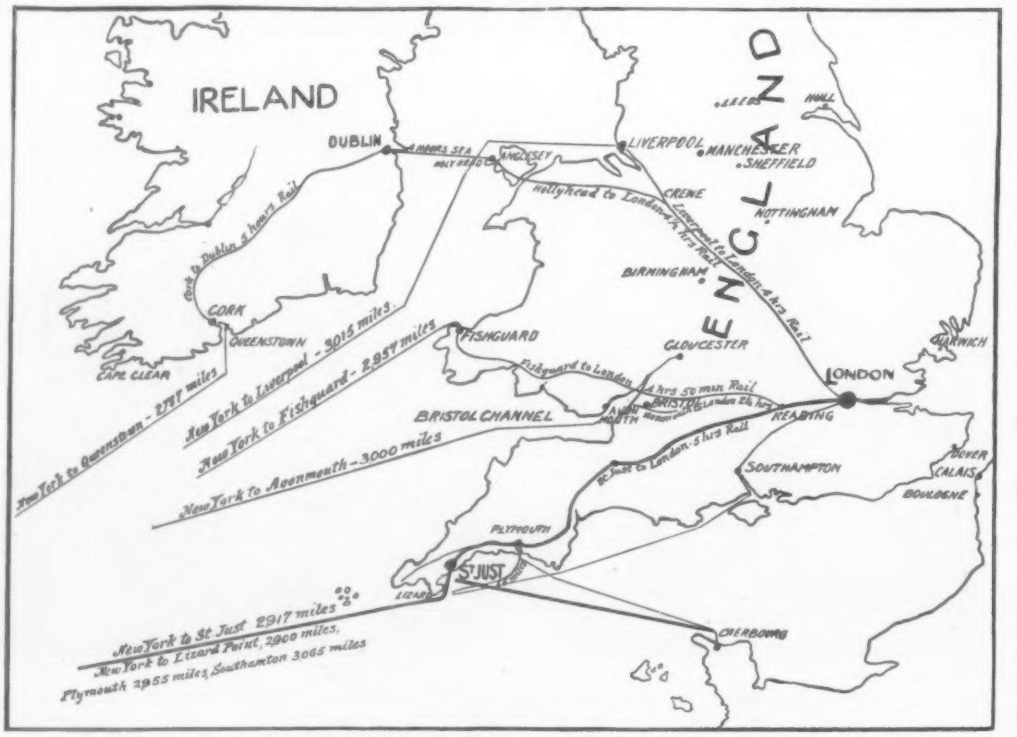
The Right Hon. Lord Pirrie of England said recently that his country is just beginning to build the type of large steamships which will carry the trade of the great continents like America and Australia, but that it is only by encouraging the construction of deep water ports and great graving docks that ship building can progress.

From this it is obvious that England must find new ports to accommodate the big ships at all hours of the day regardless of weather and tides. It is quite certain that after the war the passenger and shipping traffic will be resumed on a scale larger than ever before and we can look for the 1,000-foot liner in the near future. The competition of the British and the continental steamships for the great shipping traffic of Northern Europe must center in the English Channel, and it is there that the deep water berths and docks must be constructed. Sir William White is reported to have laid much stress on the fact that it is not so much a question of big ships as of providing docks and ports large enough to accommodate these.

The necessity of deep water ports for the size of ships just described has been emphasized in statements made by the White Star managers. The have said that if they were compelled to despatch steamships like the "Olympic" from Southampton each day, on no fewer than eighty occasions each year they could not sail on time. The disadvantage would be greater in the case of incoming steamers which are liable to be delayed by bad weather and fogs. In times of national emergency, such as the present, the use of Southampton is seriously restricted under naval orders.

Shipping authorities in England have agreed that St. Just in Falmouth Harbor would make the most ideal deep water port. It is situated on the eastern shore of the harbor, which is the nearest deep-water harbor to the entrance of the English Channel from the Atlantic. St. Just is easily accessible and land-locked, and vessels of any draught or size can safely enter and leave it in any state of the tide. There is no bar, silting or scouring and little strength of tide. The harbor offers a direct and safe approach from the ocean and shelter. Owing to natural advantages the accommodation required for the modern great vessels could be constructed there at a comparatively small cost, while at the same time the advantages of the site are equally favorable for the construction of the necessary adjuncts of a harbor and docks of the first class.

Shipping and government interests of England have proposed the building of docks at St. Just. Under the powers conferred by the St. Just-in-Roseland Experimental Dock-Works Act, borings, survey and other experimental work have been carried out. This work has proved the practicability of the proposals and also furnished the syndicate with important data which will enable the construction of the docks to be effected at a minimum of risk and considerable saving of expense. The Admiralty has given its consent to the proposals. A number of local councils and other public bodies in the country have passed resolutions in its favor, and it has the support of the china-clay industry.



How the new port in Falmouth Harbor stands with reference to the present ocean routes

The deepest portion of the area proposed to be utilized varies from 60 to 75 feet at low water, ordinary spring tides and the site is so well protected that vessels of the deepest draught can, at all times, safely enter and leave the docks within which they would be unaffected by any swell or range of the sea. The deep water runs close to the shore and bank, where landing piers up to 3,000 feet in length and also various quays and jetties could be cheaply constructed, with a depth of water alongside of 40 feet and upwards at low water, ordinary spring tides, and equipped with the most modern appliances for the rapid loading and discharging of the large ocean liners and other vessels. The piers would also offer economical and expeditious handling of the Cornish china-clay traffic.

Graving docks could be constructed up to 1,200 feet in length. Such docks are much needed in the Channel and the demand for them will become more urgent with the increase in the number of very large passenger and cargo vessels, and warships.

It is proposed that the docks shall provide the most convenient and cheapest accommodation in the Channel for passengers, mail and freight carried by the liners, and for the important china-clay, coal and other traffic. It might be mentioned in this connection that since the outbreak of the war, Falmouth Harbor has been used extensively by steamships of Allied and neutral nations.

By making the proposed docks their port-of-call the American, Canadian and other ocean liners would effect a considerable saving in time as compared with calls at Southampton, Plymouth, Queenstown, etc. In the case of the larger number of slower vessels the greater disparity between the sea and land transport speeds would considerably increase the advantage to be gained by calling at St. Just. By sailing from New York to London via St. Just passengers would reach their destination six hours and fifteen minutes earlier than via Queenstown. There would also be a saving of six hours and thirty minutes over travel via Southampton. From Halifax to London via St. Just there would be a saving of eight hours over the Liverpool route. These calculations are based on the speed of the fastest Atlantic liner now running. By making St. Just their terminal port the liners would not only shorten the ocean passage as compared with London, Southampton, Liverpool, etc., but they would also shorten the time during which they are not earning freight or passage money and they would be enabled to make the greatest number of voyages in the shortest possible time.

St. Just would provide the safest and quickest route for ocean passengers and mails to and from London and the Continent, avoiding all the delays, fogs and traffic of the English Channel. Special fast boat-trains could be brought alongside the liners and the passengers and mails quickly transferred under cover. The journey by rail to and from the docks and London could be accomplished in less than five hours, and to the Midlands and North in a correspondingly short time. There is now through connection by rail between Cornwall and Dover.

Docks erected at St. Just would be in the most favorable position for the economical and expeditious distribution and collection of goods carried by the liners. These goods could be conveyed at cheap rates by an organized system of coasting steamers to and from St. Just and London, Hull, Newcastle, Bristol, Liverpool, Manchester, Glasgow, Dublin, Belfast and other places which are near to great centers of consumption and production, and also to and from the continental ports. This systematized coöperation on a large scale of the ocean and coasting trades would be merely a development of what is already being done from the ports now being used by the liners, but the principle has not been, and indeed cannot be, carried far enough in consequence of the natural disadvantages of those ports and the great increase of size of the modern steamships. There is no place in the United Kingdom that is far from a coasting port and a great many places could be reached from the seaports by means of rivers and canals as well as by rail. The heavy cost of railway as compared with water carriage in the British Isles is in favor of this coöperation of the liners and coasting vessels working from a convenient center. Freight can be carried by water to and from St. Just to London, Liverpool, etc., more cheaply than it is now carried the short distance by rail from Southampton to London.

The war has abundantly demonstrated that the life of the Empire depends upon its sea communications. Whatever the existing magnitude of the ocean-borne commerce between the United Kingdom, the Dominions and other countries, and whatever the prospects of its development in the future, the producer, the manufacturer and the merchant alike are concerned—and vitally so—with the securing of cheap and regular shipping facilities, and, consequently, with the progressive improvement of those facilities.

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

The Coal Supply

To the Editor of the SCIENTIFIC AMERICAN:

I have read with great interest an article in the February 22d issue of the SCIENTIFIC AMERICAN under the title "The World's Coal Supply." The subject is one which deserves, and is beginning to receive, careful attention and intelligent discussion. The article in question sets forth with admirable clearness and force certain important aspects of the situation, but as to one vital point, the probable life of our coal reserves, it conveys a very misleading impression.

Your article exhibits a chart "How long the coal will last" which shows for the United States 4,000 years and for the world 3,400 years, with an inconspicuous note to the effect that this duration is based upon present rates of consumption. These are the figures which the casual reader will remember, his impression will obviously be that our coal reserves are practically unexhaustible, and not in any sense a matter of concern for many generations, or even centuries to come. The possible mathematical correctness of the figures in no way mitigates their essentially misleading character. The chart in question and the text of the article goes on to state that the "commercially available supply at estimated future rate of consumption" is sufficient to last 1,500 years. This estimate is fallacious beyond any possibility of explanation or qualification. While it is quite probable that some coal will remain in the ground at the end of 1,500 years, it is inevitable that within a small fraction of this period our coal will be so far exhausted as no longer to play a predominant, or even a prominent, part in industrial operations and developments.

What are the facts of the case? Let us take the United States, where, as your article correctly shows, the present rate of depletion is less than for the world as a whole. It is utterly meaningless to express life of our coal resources in terms of such a casual unit as production in 1913 or any other year. For a long series of years the coal consumption in the United States has been doubling approximately every ten years, an annual increase of nearly seven per cent. For the past three years it has been increasing at the rate of 9½ per cent per annum. For 1918 the figures thus far published show a mine production in the Eastern District of about 486,000,000 tons and in the United States of about 690,000,000 tons.

If the coal consumption were to continue to increase at the apparently normal rate of seven per cent per annum, and if the proportion of recovery from the mines were as high as two-thirds (considerably higher than has been obtained heretofore), the life of the known coal reserves of one eastern district would be 59 years; of the combined eastern, central and southern districts 65 years; of the Entire United States and Alaska, over 60 per cent of this supply being lignites and coals below the rank of bituminous, 84 years. These figures are based upon estimates of the Geological Survey. They include coal in veins as shallow as 14 inches, all coal of up to 30 per cent ash, and all known deposits within 6,000 feet of the surface. Obviously on a corresponding basis the life of the coal minable and usable under present standards would be materially less.

These figures bring out, with startling clearness, the condition which we are facing, the inescapable dilemma of suicidally rapid exhaustion of our invaluable coal reserves or of curtailment in the growth of our fuel consumption. If our supply of good, accessible fuel were inexhaustible, there is no reason to believe that our consumption would not continue to increase at the current rate of seven per cent per annum. The time is now upon us, however, when our coal consumption will be determined not merely by our needs but also by the increasing scarcity and expense of the supply. The resultant curtailment in the growth of our fuel production will carry with it a concomitant curtailment of our industrial development, a curtailment which at least can be offset only partially by increasing efficiencies and resort to other energy sources. We are using the cream of our resources, and using it too recklessly and too inefficiently.

As your article suggests, the more important immediate economies seem to be:

1. Centralization of supply of industrial and other power in huge superstations embodying every practicable measure of efficiency. Industrial power plants and electrical utilities now burn nearly half the coal mined annually. Large modern central stations have a thermal efficiency of at least four times that of reasonably good isolated industrial plants, and further improvement is possible.

2. Location of these super-stations at or near the coal mines in order to supersede railroad hauling of coal by electrical transmission of energy over wires. It is estimated that for every hundred tons of coal shipped over railroads, the locomotives hauling the coal cars burn 10 tons. On a sufficiently large scale, the total cost involved in electrical transmission from the mines would be only one-third to one-half the freight rates on an equivalent amount of coal.

3. Fullest possible development of water powers within economic limits as to costs. It must be kept in mind, however, that water power development is no panacea. The available water powers tributary to our great eastern and central industrial regions can supply only a minor part of our power needs, and our main energy source must continue to be coal. Water powers are in general very expensive, and to make their development feasible, every possible encouragement in the way of favorable legislation must be afforded, as well as comprehensive organization of power requirements in order to utilize efficiently the seasonally varying water power output.

4. Electrification of steam railroads. Steam railroads at present consume more than 25 per cent of our coal output. By electrification this would be reduced to seven per cent or eight per cent.

5. Electrification of coal mining operations; particularly in case of anthracite mines, where a mine usage of 10 per cent of the output could be reduced to 1½ per cent by electrifications, representing an effective saving at the present rate of production of nearly 10,000,000 tons annually.

6. Improvement in our extravagantly wasteful methods of coal mining. Of deposits worked to date it is estimated that more than half of the coal content has been irreparably wasted.

The improvements in practice outlined, leaving out of consideration the use of water power, would make available from our present coal production more than twice the present useful products in terms of power and heat. It is not too much to hope that most of this may actually be realized in the immediate future.

The problem of coal supply is fundamental and vital to the future industrial, economic and general social development of our country. Industrial civilization depends upon two factors, power and raw materials, but whereas raw materials are widely distributed, power sources are not. The nations or peoples holding the world's power sources, of which coal is the principal one, control the bases of the world's industrial development. Our advanced civilization, our high standards of living, depend upon use of power. They could not be supported by what men could do with their physical strength. Human labor requires power to multiply its productiveness. The present high standard of living in the United States is due primarily to our exceptionally high per capita use of power. The United States has nearly half of the better grade and more accessible coal deposits of the world, it has over half of the total known deposits of coal of all grades. North America has over two-thirds. This means that to this continent has been allotted by nature more than half of the world's potential industrial development. The extent to which this beneficient bequest, or trust, is realized, must depend upon the economy and intelligence with which it is administered.

R. J. McCLELLAND.

New York.

The 59-foot Ship and the 44-foot Canal

To the Editor of the SCIENTIFIC AMERICAN:

I note with much interest your issue of February 22d, which has on its front cover a good picture of the bow section of the steamer "Chas. R. Van Hise" on its side in the first lock of the Welland Canal and on page 171 a short article with reference to this vessel. The experiments carried out on this vessel by the United States Shipping Board were of a most unusual nature and I believe will be of considerable interest to your readers. I am, therefore, writing you in the matter thinking that you may care to correct and perhaps amplify somewhat the article in question.

The primary purpose of making the experiments was to develop a method, which would make possible the building on the Great Lakes of large vessels of 10,000 tons or more. The ship building plants of the Great Lakes have made an enviable record in the construction of cargo ships, but because of the small size of locks between the lakes and the ocean, they have been able to send out only small ships, although they regularly built for work on the lakes some of the largest cargo vessels. The development of the convoy system and the expansion of our overseas operations developed a constantly increasing demand for ships of the larger sizes. The Great Lakes with their well organized shipbuilding plants located close to our supply of steel could have been of the greatest value, if only the limitation of the locks could be overcome.

The "Van Hise" experiments developed a procedure by which these limitations could be overcome. That this was accomplished in the stress of war in a period of a relatively few months is most gratifying. The Shipping Board deserves much credit for presevering with the work. Mr. Hurley, Mr. Schwab and Mr. Piez joined in authorizing it. It was carried out by the Cleveland office of the United States Shipping Board. It is true that I first suggested the plan, but all the engineers connected with the Shipping Board's Cleveland office took part in developing it. Mr. H. N. Herriman of Cleveland in particular deserves credit for the success of details of the work, and Mr. W. F. Powers for the elaborate calculations, which fixed the locations and size of the weights employed to keep the ship stable.

The "Van Hise" is 50 feet wide, and we find that by this method we could certainly take out a ship 52½ feet wide. The widest ship previously taken out is 44 feet beam. To the layman this increase may not seem very important, but the "Van Hise" will carry over 9,000 tons, and the largest ship heretofore taken out carried only 5,500 tons. By building ships for the purpose, we are satisfied that this method will double the size of ships that may be passed through the locks.

Practically all cargo ships are wider than they are deep. Our problem was to turn one on her side and make her stable in that position. To accomplish this, we placed temporary pontoon tanks made of steel on one side of her deck. These were so designed that when she was turned on her side, she would just fit in the locks. She was turned on her side by simply pumping water into these tanks. She was turned back by letting the water run out of them. The tanks were carefully proportioned, so that in all positions as she turned, she would be stable; that is, have a positive metacentric height. The balance was a delicate one. Experiments had shown that if the weights were not properly distributed, the ship would turn completely over upon her deck.

F. A. EUSTIS.

Boston, Mass.

Finger Print Classification

To the Editor of the SCIENTIFIC AMERICAN:

In the issue of the SCIENTIFIC AMERICAN published on February 1st, 1919, appears the article "Finger Print Classification."

In this article it states that to those persons,who for any reason find it troublesome to use the old or improved Henry System of finger print identification, the writer, F. H. Robinson, of Brooklyn, N. Y., suggests the use of the Hollman Notation as adapted to all purposes and being simple and accurate.

From reading this article, I find that all of the ulnar loops will be placed under one primary number and only divided by the ridge counts in the little finger, while in the Henry System these loops are divided into 16 separate divisions making it far easier to search a record by the Henry System than by the Hollman System. Any records which have all whorls, would all be filed under one primary number without any secondary classification numbers. The Henry System provided for 81 secondary classification numbers under the primary classification $\frac{32}{32}$. There has been no provision made for approximating patterns.

I have been in charge of the Identification Office of the Navy the last ten years and am positive that this Hollman System could not be used in a file where there are a million records. It has been the practice of all finger print experts in charge of large Identification Offices to subdivide the files in each and all of the primary and secondary classifications as far as possible in order to expedite the searches. The Henry finger print system has been used by the Navy since January 1st, 1907, and has been found to be entirely satisfactory in every particular.

By the Hollman System, as I interpret it, from the article, all of the impressions in the $\frac{U}{U}$ group which have a little finger count of 15 will all be filed together regardless of whether the loops on the index or middle fingers are inner or outer. In the primary classification number, $\frac{32}{32}$, all of these whorls will fall in the same compartment regardless of whether the whorls in the index or middle fingers are inner, meeting or outer.

An idea advanced on this line of work must be practical and not theoretical.

J. H. TAYLOR.

Washington, D. C.

Strip of tape with recorded trans-Atlantic signals, together with the operator's decoding in pencil

Signaling and Talking Through Space

A Broad Introduction to the Present Status of Wireless Telegraphy and Telephony

THE recent remarkable development of wireless telegraphy and telephony is a story of coöperative invention. Prior to America's entrance into the world war, the various wireless interests were engaged in the usual business competition and only too often blocking each other's way and the general progress of the radio art by patent litigation. One might have a remarkable development on an existing instrument; but someone else had a basic patent on a feature of that instrument. So the man with the improvement was blocked by the basic patent; and the holder of the basic patent, in turn, was powerless to improve his instrument because of the blockading patent on the improvement.

A Lesson in Coöperative Invention

Then came the war. The various wireless organizations were called upon to give our fighters the very best to be had in radio instruments. Patriotism and devotion set aside all commercial and professional rivalry, and patents were momentarily overruled where the interests of our Government were concerned. And what counts for more than any other single thing, the inventors and engineers of the various radio organizations and the leading electrical and telephone companies got together and pooled their ideas and experience for the common good.

As might well be expected, much came out of this coöperative work. Indeed, the wireless telephone, which but a year or two ago was a delicate, uncertain child of the laboratory, suddenly developed into a full-sized, robust, practical means of communication available for ground use and aircraft. Baffling problems in interference prevention have been more or less solved. Long-distance stations have suddenly become operative under almost all atmospheric conditions. The business capacity of huge stations has been increased many fold. The lofty aerials formerly required for long-distance reception have been abandoned for underground aerials and small loops from three to six feet in diameter, erected four or five feet above the ground. And so it goes with many other features of wireless, which only yesterday were considered the far-off goal of wireless men and which today stand practically perfected as a result of unselfish, coöperative effort.

Space here does not permit of a complete review of the radio art, such as the author would wish to make in order to give the reader a bird's-eye view, so to speak, of what has gone before and since our participation in the war. Volumes could be written on the development within the past year. However, it is necessary to assume that the reader is more or less familiar with the broad principles of radio communication, and has followed the various earlier developments of the art.

Ways New and Old of Generating Radio Waves

Turning first to transmitters, we find spark transmitters still employed to a large extent, although many new forms of transmitters have made their appearance. One of these is the arc generator, which, if not absolutely new, is at least greatly improved in its present form. It is widely employed both in Europe and America. Starting with the simple arc of the Danish inventor, Poulsen, back in 1906, radio engineers have brought this generator to a high state of perfection for long-distance telegraph and telephone transmission. In fact, the recent development of the vacuum tube as a modulator of circuits has made it possible to impress telephone conversations on the most powerful arc transmitter, thereby making the latter more than ever available for practical wireless telephony.

For years wireless engineers have appreciated the convenience and practicality of the high-frequency alternator as a means of transmitting. However, there is a vast difference electrically and mechanically between the generating of currents of 60 or 133 cycles, as in commercial power circuits, and the 20,000 cycles required for radio transmission. Still, these electrical and mechanical obstacles have been slowly overcome, both here and abroad. Among others, there has been the Goldschmidt alternator, which makes use of a most ingenious winding scheme for multiplying the frequency within the machine until radio frequencies are obtained.

The Goldschmidt alternator has been in use for some time past, particularly at Tuckerton, N. J., and Eilvese, Germany, giving excellent results. Driven by a 220-volt, 250-horse-power motor at 4,000 revolutions per minute, the Goldschmidt alternator supplies radio-frequency currents. The accuracy of construction of such an alternator is extreme; indeed, the air gap clearance between rotor and stator is but 0.03 inch, and a deviation from parallelism of one part in a thousand causes the output of the machine to be reduced by one-fifth.

As far back as 1908, Dr. Ernest F. W. Alexanderson of Schenectady, N. Y., constructed an alternator delivering approximately two kilowatts of 100,000-cycle current. The rotor of this alternator made a speed of 20,000 revolutions per minute, the actual speed at the rim being 12 miles a minute. Other inventors have also worked on high frequency alternators, and all this work has finally given birth to the present successful generators. The advantages of this type of generator are numerous. For one thing, it gives a steady, uniform supply of radio energy, which only needs to be controlled by telegraph key or microphone amplifying circuit, according to whether telegraphy or telephony is sought.

Telephoning Through 3,200 Miles of Space

Recently Dr. Alexanderson's apparatus was employed by the Navy Department at New Brunswick for transmitting wireless telephone messages to President Wilson on board the transport "George Washington" at Brest, France, or over an air-line distance of 3,200 miles. And, according to this leading radio engineer, this is by no means the limit for wireless telephony, especially when better facilities are available.

The station at New Brunswick, employing Dr. Alexanderson's high-frequency alternator, may be used either for wireless telephone or telegraph messages without alterations, and for simultaneous transmission and reception of either. The alternator at this station has a frequency of 22,000 cycles, and the only moving part is a solid steel wheel without wires or copper conductors, constituting the rotor. This member revolves at 2,100 revolutions per minute. The output is 200 kilowatts, and the emitted wireless waves have a clear-cut whistle or flute-like sound, with no harmonics. It should be remembered, how-

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At the left: Receiving trans-Atlantic messages. *Above:* Operating the special perforating machine which punches the automatic, high-speed transmitter tapes. *At the right:* Each of these tables in Washington controls one of the most powerful Navy stations

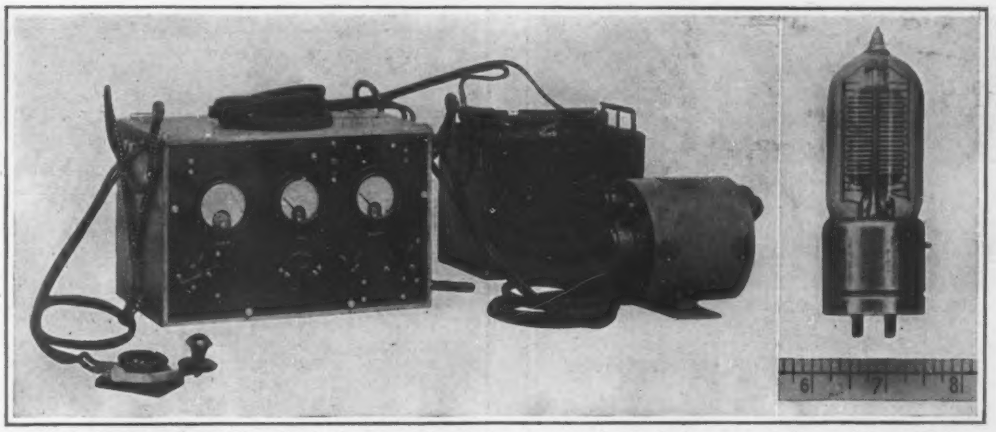
Views of the trans-Atlantic room in the new Navy Department Building in Washington, D. C.

ever, that these waves are inaudible because of their high frequency, and special means are employed at the receiving end to convert them into audible or readable signals. Harmonics, Dr. Alexanderson explains, have various frequencies and different wave lengths, and interfere with other stations. They are useless wave lengths which fringe signals.

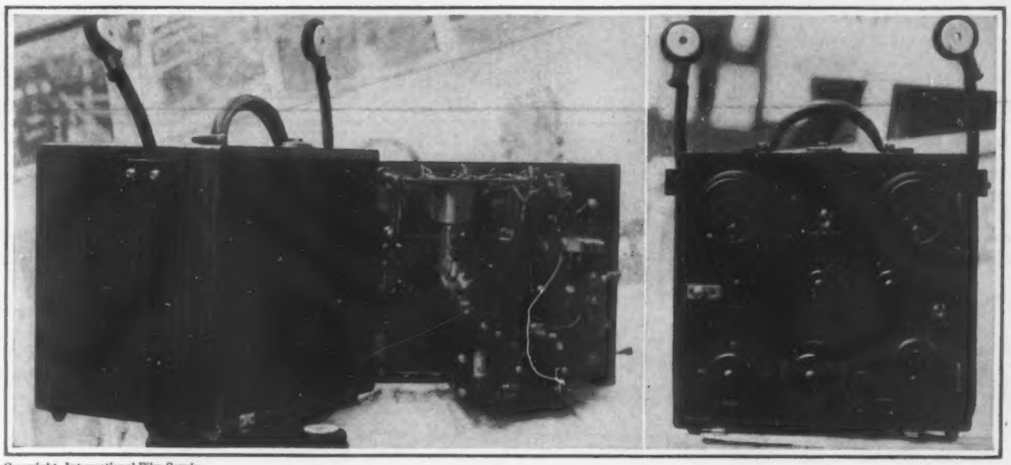
In conjunction with his alternator, Dr. Alexanderson makes use of a magnetic amplifier, which builds up weak currents until they become sufficiently powerful for long-distance transmission. This device contains no moving parts; magnetically, it controls the output of the alternator at the bidding of a telegraph key or microphone. As far as the 'ayman is concerned, the magnetic amplifier may be described as a special form of transformer.

Still another feature of the Alexanderson system is the multiple-tuned aerial, which is said to purify as well as amplify the particular tone or vibratory requency of the station's generator. Dr. Alexanderson makes his aerial in electrical harmony with his transmitter, whereas the general practice has been to use any kind of aerial for handling the transmitter's oscillations. A suitable analogy is the phonograph: the cheaper machines are merely assembled, with any reproducer, tone arm, horn, and cabinet being brought together to form a machine. The more expensive machines, which really reproduce something like the living sounds, are not merely assembled —they are carefully balanced. Each part is balanced against some other part, so that the acoustic ensemble is a perfect unit. So with the Alexanderson transmitter and aerial; they must agree so that there will be no opposition or depreciation. As a result of this balance, the range is greatly increased. Thirteen poles, each 400 feet high, are employed for the aerial at the New Brunswick station.

The Alexanderson system is also employed in the powerful wireless station at Lyons, France, which has been handling the official United States Government traffic between the two countries. The aerial of this station comprises 20 parallel strands of phosphor bronze cable extending over a distance of 2,400 feet and supported on eight steel masts measuring 650 feet in height. The station makes use of several transmitting sets, namely, a 150-kilowatt Alexanderson high-frequency alternator, a French high-frequency alternator of the Bethenod design and of the same capacity, two 250-kilowatt Elwell arc generators, and two 150-kilowatt spark sets. It is understood that the two high-frequency alternators have not as yet been put into operation.



Typical wireless telegraph and telephone set for airplane use and a typical vacuum tube used in receiving



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Interior and exterior views of a wireless transmitter for airplane use

Vacuum Tubes—The Modern Alladin's Lamp

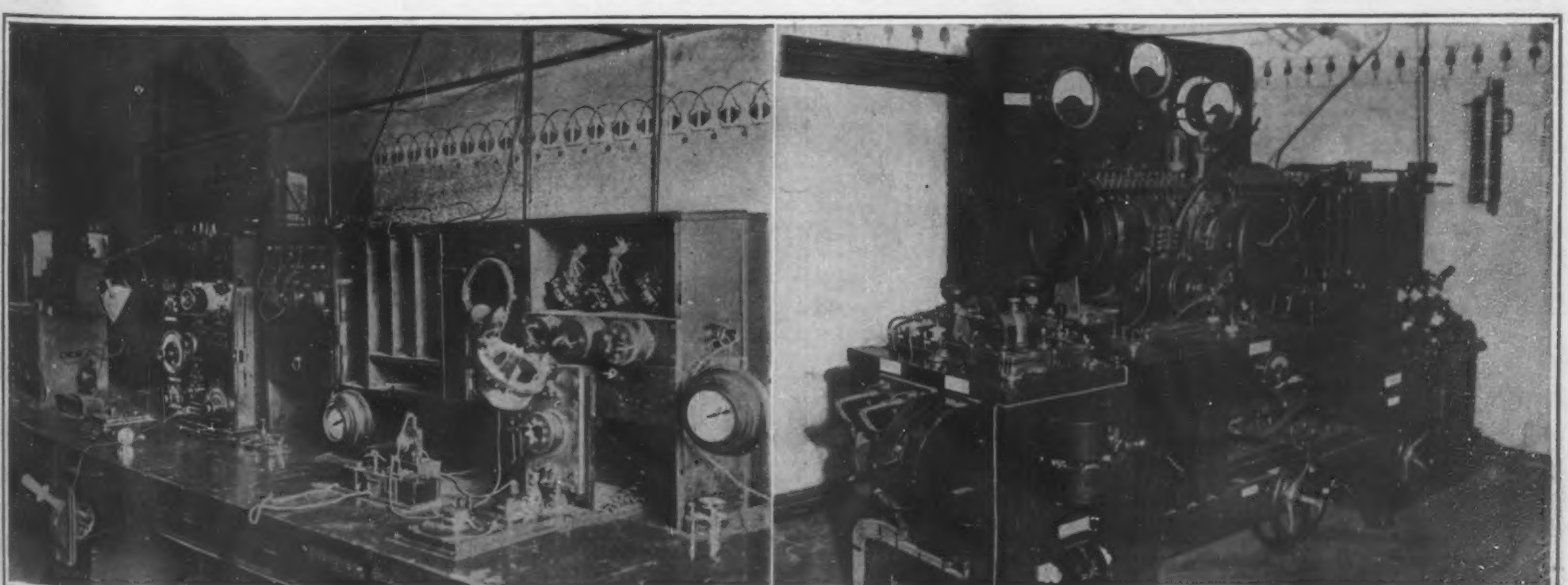
And now we come to the most remarkable development in radio communication—the vacuum tube. Many years ago Edison discovered that when an electrode was inserted in an ordinary electric bulb and the filament heated to incandescence, current flowed from the filament to the electrode. In other words, the lamp became a uni-directional conductor, and was thus available for rectifying purposes. This phenomenon has since become known as the "Edison effect."

After Edison, numerous prominent inventors took up the Edison effect and studied it with a view to making some use of this simple rectifier. Among them have been Fleming, DeForest, Langmuir, White, Armstrong Craft, Colpitts, and others. The story of the gradual development of the vacuum tube, as it is commonly called, is a long one, but suffice it to say here that up till 1912 no remarkable progress had been made.

Then it was that the telephone interests, with a view to improving their long-distance service by introducing means of repeating or amplifying weak currents, decided to investigate the vacuum tube. From a comparatively crude instrument the telephone engineers, with every facility available for extensive research and experiment, soon evolved highly perfected vacuum tubes which became competitors of the so-called "mechanical" repeater, which they are rapidly displacing. Ordinary telephonic communication is not feasible over 500 miles, without some means of repeating or relaying the attenuated current coming from the transmitter. Thus for distances between 500 and 1,200 miles, two amplifiers or repeaters are employed. In speaking through to San Francisco from New York city, a person's voice travels through six vacuum tubes.

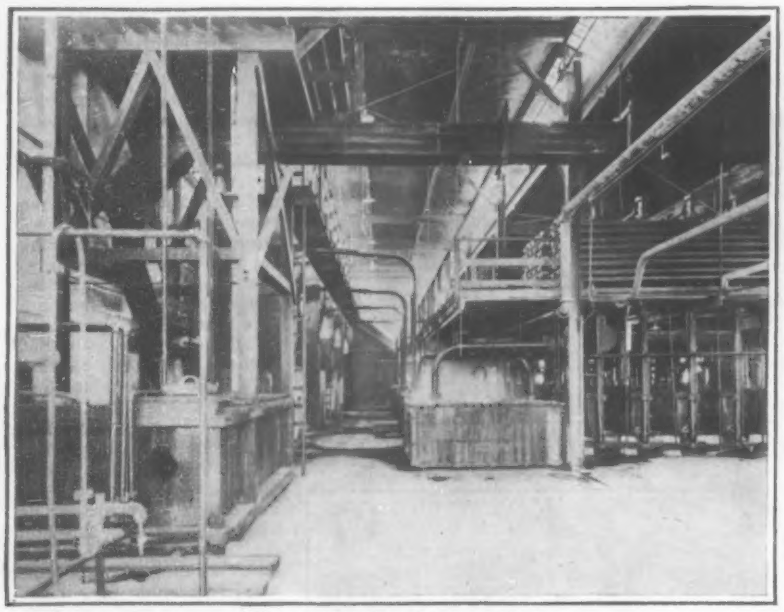
And while the vacuum tube, in its perfected form, practically perfected long-distance telephony and multiplex telephony, it all the while became better adapted to radio communication. Appreciating its vast possibilities, the telephone organization back in 1914 began wireless telephone experiments between an experimental station at Montauk, L. I., and Wilmington, Del. In April, 1915, good wireless telephone transmission was achieved between the two stations. This experimental and development work was steadily expanded by the telephone organization's engineering staff and numerous radio engineers, until, on October 23d, 1915, telephone messages were transmitted through space from Arlington, Va., to the Eiffel Tower in Paris, France, a

(Continued on page 383)

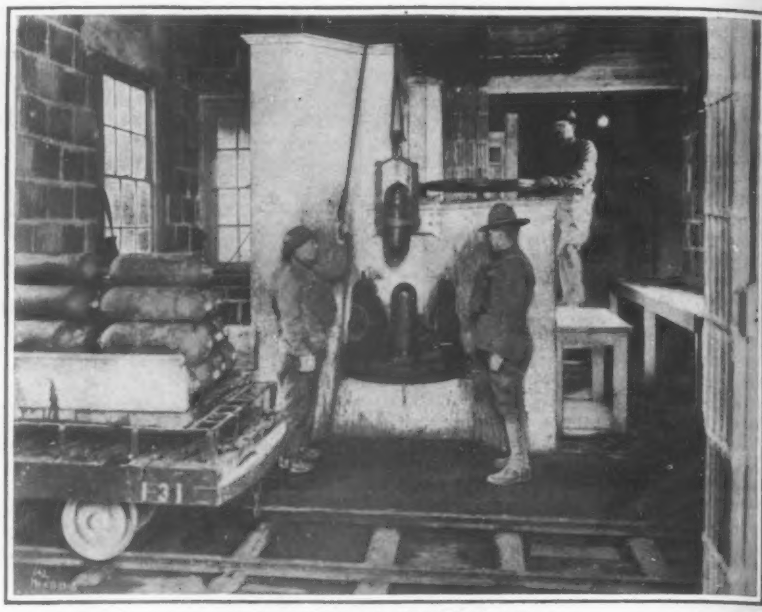


At the left: Some of the receiving apparatus which, to all indications, is by no means the last word in the art. *At the right:* Powerful arc transmitter

Two views of the Metz wireless station which the Germans surrendered to the French since the armistice



Mixer unit in the phosgene plant



Filling Livens shells with phosgene

United States Chemical Warfare Service—II

The Great Gas Plant at Edgewood Arsenal With a Capacity of 200 Tons Per Day

IN our issue of March 29th, 1919, we dealt with the construction of the great toxic gas plant at Edgewood Arsenal, Maryland, where, in considerably less than twelve months of active construction, we built from the ground up a vast establishment, and developed an industry entirely new to the United States. At the signing of the armistice Edgewood had a capacity of approximately one hundred tons of gas per day, and, by the close of last year, would have been in a position to ship to the front the enormous output of 200 tons of gas per day and maintain that rate of supply continuously. The significance of this will be appreciated when we bear in mind that the total daily capacity of the German chemical plants was only about thirty tons per day.

In addition to the manufacture of chlorine and mustard gas, as described in the preceding chapter, the Edgewood plant was in a position to produce large quantities of phosgene and chlorpicrin. It also included a shell-filling plant of large capacity, and separate plants for filling hand-grenades with both gas and smoke-producing materials, and for manufacturing incendiary bombs and darts. Also, there was built a very fine chemical laboratory, thoroughly equipped with all the necessary appliances, in which the various processes for the operation of the different sections of the work were determined, and a large amount of research characteristic of the routine of laboratories was carried on. The work of this kind previous to the construction of a laboratory at Edgewood was done by placing the members of the laboratory force in various laboratories throughout the country, and notably at the Bureau of Standards, Washington, Johns Hopkins University, and the Ohio State University.

The Manufacture of Chlorpicrin

Much was heard during the war of the gases used by the Germans to temporarily blind the enemy by acting vigorously on the tear ducts. This was commonly known as "tear gas." At Edgewood there was built a very complete plant for the manufacture of chlorpicrin, which not only has a strong lachrymatory effect, but also is a powerful lethal gas. Because chlorpicrin is liquid at normal temperature and pressure, it is necessary to use in projectiles filled with this gas a rather stronger explosive charge than is necessary when a real gas such as phosgene is used as the filler. Chlorpicrin is produced by the reaction of bleaching powder upon calcium picrate, the reaction taking place in wrought-iron digesters which are furnished with condensers. So long as the temperature of the reaction remains within the very definite and limited range in which the chlorine in the bleaching powders reacts upon the calcium picrate, the reaction takes place very evenly. But if the temperature passes outside of these limits, the bleaching powder liberates oxygen in place of chlorine and the entire mixture foams over into the condenser.

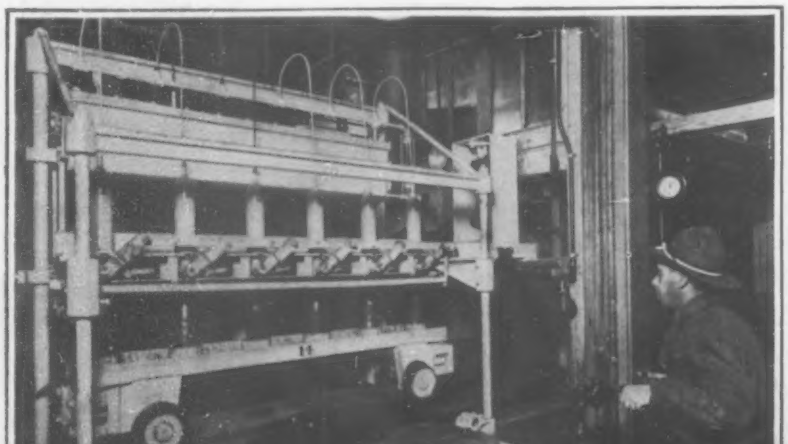
When the reaction takes place as intended, the chlorpicrin distils out and is separated from the accompanying water after being conveyed to settling tanks and allowed to stand in them for a few days. At a plant which the Government employed at Stamford, Conn., the picric acid was produced from phenol and was used directly in making chlorpicrin. Picric acid for the Edgewood plant was provided from other government plants.

Chlorpicrin was used as a filler for all kinds of projectiles, the shells sometimes being filled entirely with chlorpicrin and at other times containing a mixture of chlorpicrin and phosgene or stannic chloride.

The Manufacture of Phosgene

A most effective gas, because of its high toxic power, is phosgene, and the plant erected at Edgewood had a capacity at the close of the war of 40 tons per day. Two additional plants were practically completed which would have brought the total capacity at Edgewood up to 80 tons per day. The Government was also supplied by a plant operated by the Oldbury Electro-Chemical Co., which made use of the carbon-monoxide from its phosphorous furnaces, and this plant contributed ten tons per day, part of the output being loaded into projectiles at the plant and the rest of it shipped abroad in steel containers. Also a plant at Brook, N. J., was turning out some five tons a day which was shipped in containers to the Allies.

Phosgene has a very strong delaying action upon the heart, which may prove fatal even after the first effects seem to have disappeared. In the manufacture of

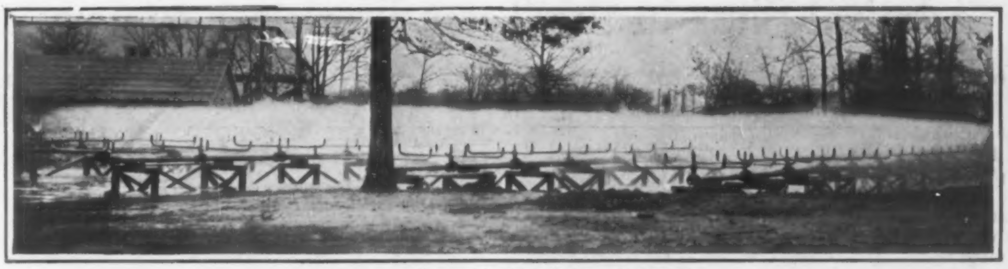


Filling 75-mm. shell with mustard gas

Painting gas shells as they pass on moving trolleys

phosgene, the reaction of carbon-dioxide and carbon is combined with the reaction of oxygen and carbon in a gas producer from which pure carbon-monoxide is obtained in large quantities. Destructive temperatures are avoided by regulating in the process the relative amount used of oxygen and carbon.

The phosgene plant at Edgewood consists of a carbon-dioxide plant with a daily capacity of 125,000 cubic feet of carbon-dioxide and an oxygen plant capable of producing 200,000 cubic feet of oxygen every 24 hours. Four producers gave a total daily output of 400,000 cubic feet of carbon-monoxide. The carbon-monoxide and chlorine then travel over a carbon catalyzer, and the phosgene is produced with a tendency to very high temperatures which is restrained by cooling. The phosgene is then liquefied by passing it through condensers immersed in refrigerated brine.



Spray-cooling water for the condensers

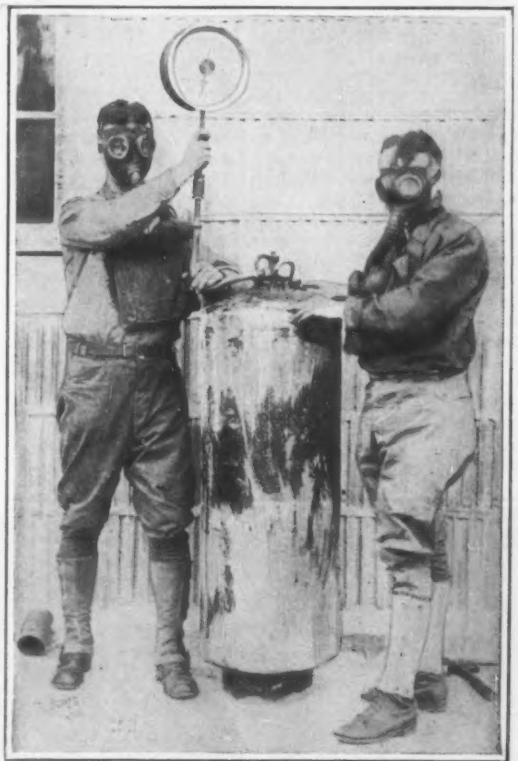
The output of phosgene at Edgewood was used in filling standard shells of all calibers, Livens projector bombs and Stokes mortar bombs. Big shipments were made to the Allies in wrought-iron drums or containers, each of which held 1,700 pounds. A large group of these is shown in one of the accompany illustrations.

The Shell-Filling Plant

The shells and bombs for carrying the gas into the enemy's trenches and into the terrain back of his front lines were shipped to Edgewood from the various shell plants and stored in large dumps, from which they were taken as needed to the shell-filling plant, which was designed for the filling of shells of all calibers from 75 mm. to 240 mm. In order to make sure that the phosgene was maintained in a liquid condition at atmospheric pressure, the shell-filling plant was equipped with the necessary refrigerating appliances for reducing the temperature of the phosgene and of the shells. The shells to be filled were brought by conveyors through rooms in which the temperature was 0° F. and unloaded in front of the filling machine at a temperature well below the boiling point of the gas. The filling machine, of which we show an illustration, is arranged to fill six shells at a time and the filling is done within a glass-enclosed cabinet. The liquid phosgene is delivered by small tubes into containers of the exact capacity of the shells, which are filled six at a time. The shells are brought into the cabinet on a trolley, and they are so placed that the heads of the shells register correctly with the outlet of the flasks above. The cabinet is so arranged that the discharge of the contents of the flasks to the shells can be regulated by an operator outside the cabinet, and means are provided by which not even a drop of the liquid can fall outside of the shells. The shells are closed by compressed-air motors. As soon as the set of six is filled, the trolley passes out of the cabinet, taking the filled shells with it.

The next operation is that of painting the shells with certain colored bandings which show at a glance the nature of their contents. Painting and striping were done on an endless conveyor, which carried the filled shells in front of a number of operators, each of which performed his share of the work. It is needless to say that every part of the plant for shell-filling was most carefully ventilated, the tail-gas being washed in lofty stone-ware towers which are constructed on the lines of the standard silo.

The shell-filling plant has a capacity in 24 hours of filling 80,000 77 mm. shells, 10,000 4.7 mm., 50,000 155 mm. and 4,000 8-inch shells.



Charging tanks with phosgene gas was hazardous work, calling for gas masks

In conclusion, we wish to say that among the many great industrial plants which we have visited from time to time, we do not recall any other governmental work which surpasses this in the intelligent prevision with which it was laid out, the speed with which it was erected, and the brief period of time in which production on a large scale was accomplished. We wish to re-affirm our conviction that the Government should regard the Edgewood Arsenal as a great military asset. The cost of a few caretakers would be insignificant, and we believe that a far-sighted policy on part of the Government would see to it that the plant is preserved in such condition that, should any future call for military mobilization arise, it could be put into immediate operation.

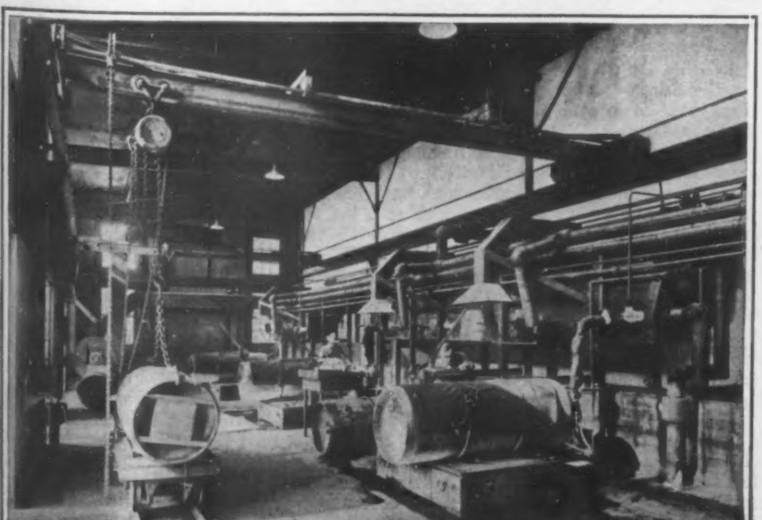
Training Field Workers in Eugenics

DIRECTOR C. B. Davenport, of the Eugenics Record Office on Long Island, assisted by Dr. H. O. Laughlin, has been giving every summer since 1910 a six-weeks training course for field workers in eugenics. The course comprises 25 lectures on human heredity and eugenics, with special referenсg to conduct, together with laboratory work on charting family pedigrees, tracing the descent and recombination of human traits in pedigrees, statistical studies on variation in plants and animals, studies in the elements of biometry, etc. Clinical studies are made at institutions for various types of the socially inadequate.

Personnel Work of the United States Army

THE principles and methods developed by the Committee on Classification of Personnel in the Army have been summarized in an exhibit which is being shown in various cities. At present or up to April 12th the exhibit is at the Engineering Societies' Building, 29 West 39th Street, New York City. It consists of a collection of wall charts, forms, photographs and models showing how the Army finds out what kind of work men can best do and how it places them on such work, in so far as it is needed in the Army; how men who claim to have skill in trades essential to the Army are tested to develop the extent of their skill; how the intelligence, talent and skill available are distributed throughout the different Army units; how officers are classified to ascertain their special abilities; how they are rated for efficiency, and how this information is used, and the general results of applying modern personnel methods in the Army during the war.

The exhibit was prepared by the Adjutant General's office at Washington for the information of officers and civilians in that city, where it received such favorable attention that in response to many requests the Adjutant General consented to its display in other cities. Very appropriately it is being shown under the auspices of the United Engineering Society, representing the four great Engineering Societies, and the National Association of Corporation Schools, which represents the first successful attempt at nationalizing the study and investigation of the relations between employer and employee. Over fifty different industries are represented in its membership, their mutual purpose being to increase the efficiency of the industries of the United States through industrial training and to supplement the educational efforts of the Public Schools. The Association, through its various sub-committees, conducts intensive study of all features of employment and training and prosecutes vigorous activities for the elimination of waste through unnecessary labor turnover, through lack of proper training and unnecessary sickness and accidents.



Filling 1700-pound containers with liquid phosgene

Phosgene in wrought iron drums ready for shipment to France

Admiral Sims in the Team-Work for Victory

How the Admiral Stood Out for Consolidation as Against Mere Coöperation

IT is not stretching a point too far to say that the greatest ally of Germany, during the first four years of the war, was the lack of a unified command among the Allied armies opposed to her. Admiral Sims has earned the lasting gratitude of the nation at large and his brother officers in particular, because he stood for the closest consolidation under single leadership, and not merely for simple coöperation with our Naval Allies. Only thus, as the event has proved, could the quick defeat of the submarine, the capture of the High Seas Fleet, and the transfer of 2,000,000 American troops to Europe have been accomplished.

FROM the very moment that Admiral Sims took command of our European Naval Forces in this war, he adopted a few outstanding policies which are typically characteristic of his methods, and which are largely responsible for the efficiency of our naval forces which operated with foreign navies with which they have come out of the war. The walls of secrecy that existed between all navies in time of peace, together with the typically American characteristics which existed in our own Navy, caused our Navy to develop methods and practices peculiar to itself, and at the same time, quite different from those existing in other navies.

It was natural, and quite to be expected, that when our ships were required to work as a team with foreign navies, these differences in methods and practices were suddenly thrown into the limelight. In the opinion of our own Navy, at least, a great many of these methods and practices were considered far superior to the methods and practices found in vogue in the foreign navies. It was also inevitable that a spirit of competition and rivalry should at once start to grow up. It was therefore to be expected, and was quite natural, that our officers should resist changing their own methods, and that all sorts of sources of friction should thereby arise. A marked tendency existed in the beginning to keep our ships separated from foreign ships, to give them areas to operate in by themelves, so that the work they did would be clearly contrasted with the work of other navies. In joint operations of navies, questions of pride and prestige are inevitable factors.

Admiral Sims' policies were aimed to cover all of the above, and many other points which always exist in allied joint operations and for which there naturally cannot be any previous training in time of peace. It is perhaps natural that his policies have been misconstrued by many who were not acquainted fully with the most unusual circumstances of such an unprecedented war.

At the very outset he clearly set forth that the one and only task confronting our ships was *"to defeat the enemy"—"to win the war,"* and that no other considerations were to be allowed to interfere with this one outstanding aim. Questions of pride, prestige, relative value of methods, etc., should be sacrificed to the above single aim. The watchword was to be "team-work." Wherever possible our ships and men were not only to coöperate with the foreign ships and men, but were to consolidate with them into "one team."

Except where absolutely necessary, our ships were not to build up duplicate administrative organizations, duplicate lines of communication, duplicate supply stations, etc. There was a natural tendency to build up our own separate supporting systems so that whatever "show" we entered into would be our own. The Admiral preached that the best way to "win the war" was to take conditions as we found them and work with them, thereby not only saving great and unnecessary expense, but also saving long delays which would be involved if we had to wait for this and that to be brought from home, let alone the unnecessary demands upon shipping which was really the vital factor in the war—to cut out growling—to get in the game with both feet.

The Admiral made it clear to his officers that their game was to avoid delay in hitting the enemy, and to stop at nothing no matter what they had come to believe in the past, which would diminish in any way their throwing their maximum weight into the scales without delay. In war, "time" means everything. Time is an all-important factor. Hit the other fellow first—the faster and quicker you defeat his game, the sooner the sacrifice of precious life, the waste and expense of war are over. Most earnestly he pointed out that it did not make any difference what our ships were doing, what ships they were protecting, or where they were working, as long as they were hitting the enemy to the best advantage in speeding the day of victory. As to differences in methods and practices of foreign services, the British service was the principal one concerned simply because it was by far the largest and hence the one with which our Navy naturally came in the most contact. He insisted that it be decided in general Allied council as to where our ships would be of the greatest service.

The Admiral constantly directed the point of view of his officers to the following inescapable facts: We were greatly outnumbered in ships, men, material and everything else in the game. In every phase the other fellow, who outnumbered us, had been at it for nearly three long years. In other words, we were entering a war in its last phase, not in the beginning. He never questioned but that many of our methods and practices were superior to the corresponding ones in the older navies. He pointed out that, as we were decidedly in the minority and the other fellow had settled down to his paces, it would only slow the game down and *help the enemy*, to attempt to force the other older navies to

Presentation of a parting gift to Admiral Sims in London

adopt our methods or to convert them to our views. The task of persuading the other navies to change their methods would simply involve lost motion and delay. The war was no time to try to educate or change the other fellow. Hence all of his officers were directed and encouraged, regardless of red tape and regulations, to unhesitatingly drop, for the time being, their own methods and practices, if by so doing delays and friction could be avoided, and the enemy hit the harder. Of course, 100 per cent efficiency could not be expected. Where we could work our methods in without confusion or delaying the game or causing friction—fine—go ahead.

In other words, Admiral Sims' policy was, that in any game of coöperation, concessions must be made. All parties may be heard at the Council Table, but when it comes to action, one side must give way. This is the principle of unified command, later adopted on the Western Front, and incidentally it is the guiding principle of all successful enterprises in civil life.

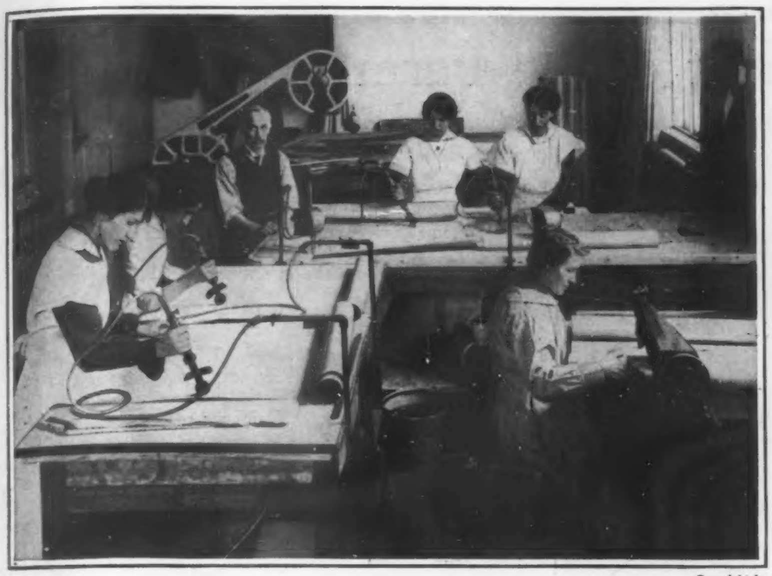
Admiral Sims preached a doctrine, easily misconstrued by those who did not fully understand—his doctrine was that as we were decidedly in the minority, we should be the quicker and show the greater willingness to give way in our arguments and contentions; and this for the good reason that our aim was not to prove our case, or to prove our superiority in this line or that line, but solely to defeat a common enemy. He repeatedly said, "Never mind about the credit, or prestige, or recognition, but get on with the war." It is difficult to explain but, nevertheless, only too true, that Admiral Sims' path, in ensuring that such policies as the above were carried out, was not strewn with roses. It would take a volume of no small size to chronicle the troubles that arose or tried to arise, or the obstacles which encumbered his path. From the moment he arrived in Europe, which was two days after the United States declared war, he stood out for the above policies in all of his work, not only with his own ships, officers and men, but also in his dealings with the heads and the organizations of foreign navies. In other words he at once adopted the policy of unified command, which latter attracted so much world attention when it was announced as being adopted by the armies in the field.

Admiral Sims took the stand in the Allied Council Chambers that his forces should be looked upon as "reserves" being brought up to the "front." That where they should go and in what numbers should be determined only after frank discussion by everyone concerned; and should be based only on the general and strategical situation, and with the sole end in view of winning the war. This policy is quite opposed to the one which natural inclination dictates. We had a navy which was a separate team in itself, with its own methods and its own traditions. It had been preparing for this day for many years. It was only human and natural impulse that it should resist being broken up and scattered. It naturally did not relish being mixed with detachments of the navies of other nations and being separated from its own traditions and methods. However, such were the conceptions of our principal naval commander in the war, and who can question the high motives and unselfishness which they typified.

Results only count, and now that the war is over the fact cannot escape that our Navy in the war under the leadership of Admiral Sims, has come home with nothing but praise and admiration and respect from the foreign navies with which it has worked. Practically no word of criticism, either through official or unofficial channels has been heard. Admiral Sims himself in some quarters at home has been criticized, this being due to misinterpretations of his policies and methods. Fortunately, however, he is a big enough man not to allow these criticisms to interfere with his continuing to be governed by his own convictions based upon his experience.

As a result of the above, our naval ships were scattered throughout the war zone, for example, in the White Sea, the North Sea, with the British Grand Fleet, in the Irish Sea mixed with the British command, off the French Coast mixed with the French Command, Gibraltar, mixed with the British, the Adriatic, mixed with the Italians, and on shore it was found in aviation mixed with the British in Ireland and England, on the shores of the North Sea, in Flanders mixed with the French, Belgian and British, on the French Coast mixed entirely with the French, in Italy again mixed with the Italians. It was mixed principally with the British for one reason alone, and that was on account of the size of the British navy, which was scattered through all the areas above mentioned. It could not have been otherwise. In view of the size of Britain's navy it was natural that the French and the Italians should not have attempted to increase their navy or make up their losses during the war. Their attention was principally directed toward their armies.

(*Continued on page 384*)



In the army clothing factory—making stencils with electric and gas tools that perforate the paper to the required design

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Welding aerial bombs—a man's job done as a man would do it, by a woman with a man's heart

British Munitions

A Glimpse at a Picture Too Big for a Single Canvas

By C. H. Claudy, Special Correspondent of the SCIENTIFIC AMERICAN in London

HANGING on the wall of one of a thousand of England's Munition Offices is this quotation from Sir Walter Raleigh:

"Whosoever in writing a modern history shall follow Truth too near the heels, it may haply strike out his teeth."

Written in 1614, it has lost none of its potency in 1919, especially to him who would attempt the impossible task of painting a true picture of Great Britain's munitions work in a single article. The present writer needs his teeth, if only to have something to hook into the next story, and so he feels that there may be some excuse if he does not follow "Truth too near the heels".

To get even a faint idea of the program it seems fairly obvious that one first envisage what "Munitions" means. If it means guns and shells, the answer is simple—the Ministry of Munitions will supply no figures until a peace treaty has been signed. If it means all war material, then the pages of one issue of the SCIENTIFIC AMERICAN could not hold the mere statistics if they were available.

The act establishing the Ministry of Munitions was passed on June 9th, 1915, and special powers were conferred upon the Minister of Munitions by an Order in Council dated June 16th, 1915, the Munitions of War act, 1915, and subsequent acts and the Defence of the Realm acts. Mr. Lloyd George took up his work as Minister of Munitions on May 26th, 1915, the nucleus of the new department being formed by the staff of the Cabinet Committee on Munitions together with that of the special organization established at the War Office under Lord Kitchener for the development of munition supply, known as the Armaments Output Committee.

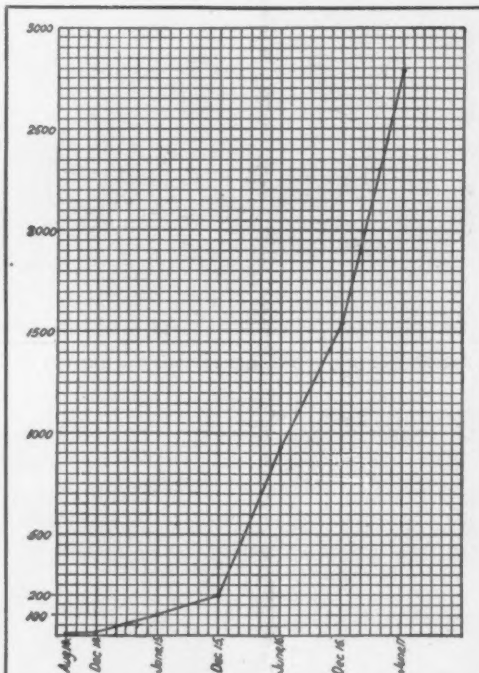
To these were rapidly added certain older sections of the War Office organization. This process of transfer from the War Office was carried further in later months, and by the end of 1915 the scope of the department covered the supply of arms, ammunition, explosives, optical munitions, materials, trench warfare supplies, munitions contracts, munitions finance, inspection, invention, design and the administration of the Royal Ordnance Factories, these functions being, in the main, duties which had formerly been exercised by the War Office.

During 1916 the Ministry of Munitions was entrusted with further responsibility for the storage of gun ammunition, supply of tanks, supply of tractors for heavy howitzers, supply of railway materials for the army, supply of mechanical transport vehicles, and the supply of chemical glass and laboratory ware.

Since December, 1916, these functions have been further extended to include the highly important department in charge of the supply of heavier-than-air aircraft for both land and naval services, as well as the development of agricultural machinery supply on behalf of the Board of Agriculture. Since June, 1917, the Ministry of Munitions has also been responsible for the supply of fuel oils.

It seems fairly obvious that to tell the story of such a department, needs not an article, but an encyclopedia! But perhaps if a few high spots are touched, the reader may gain some perspective on the size of the picture if not of its just proportions.

During the last four days of fighting before the armistice Great Britain's guns used up 12,500 tons of ammunition daily. Neither then, nor any time since the dark days of the German offensive, has Great Britain expended ammunition faster than it could be supplied. During that German offensive the English army lost in one week 1,000 guns—and less than a month later had 1,500 new ones to take their place. We are fond of talking about speed of production in the United States, but the Briton has certainly little to learn when an armed foe is menacing his island integrity and his pride is touched that a Hun can get at him overhead and undersea!



Graph showing the increase in production of munitions by weight

For purposes of comparison the production in June, 1915, when the Ministry of Munitions was founded, is taken as 100

Few people have much of an idea as to just what a single round of ammunition really means from the manufacturing end. Quite apart from the obvious things, such as shell, case, explosive, etc., before a single round can be manufactured it is necessary to obtain and work up emery stone, cryolite, calcium carbide, magnesite, wolfram ore, acetone, carborundum, nickel, bauxite, nitrates, oil, cotton, antimony, and many other items from different countries. Forgings and castings must be supplied as well as brass rod and stampings, an infinity of machining operations must be done, along with the superintendence of equipments, the ordering of the machinery, the manufacture, distribution and supply and use of hundreds of gages, the assembling of ingredients from different works in appropriate centers, the calculation of the raw material, the arrangements for transport, and so forth.

Further to elaborate on the complication of shell and ammunition manufacture, consider a few figures for the inspection service which the factories in England possess, to see that what is turned out is as right as human care and ingenuity can make it.

In July, 1915, the staff of the Inspections Department consisted of 8,761 persons. In June, 1917, it consisted in England of nearly 40,000 with an additional staff in the United States of more than 8,000. Women are employed in every possible way. In March, 1916, they composed 28 per cent of the staff; in June, 1917, they composed 61 per cent, numbering 29,000, and they are employed on almost all operations except those in which special technical experience or physcial strength are required.

The work of inspection, is often very tedious and monotonous. When it is remembered that there are no fewer than 183,000,000 separate gaging operations for every million rounds of shell, it can easily be seen why it requires both many workers and great fidelity to accuracy in the work.

There are in Great Britain—or were at the time of the armistice—upwards of 20,000 factories engaged in munitions work exclusively. The vast majority of these, of course, were private factories, operated under strict Government control. The Ministry of Munitions has full and complete powers to help itself to any factory, take any labor, commandeer any machines or buildings that it needs—and it is only fair to say that this enormous power, perhaps greater than that possessed by ancient kings prior to Magna Charter, has been used with the single-minded desire to "win the war" and with a resulting friction and discontent so small, as to be a matter of amazement to the American observer, whose inalienable right it is to grumble at his government, even when most enthusiastically supporting it. Most important of the factories are the national factories. On the 31st of October,

(Continued on page 384)

Mechanical Equipment of the Farm

Latest developments in agricultural machinery and practical suggestions for the farmer

Conducted by HARRY C. RAMSOWER, Professor of Agricultural Engineering, Ohio State University

An Acetylene Table Lamp

ACETYLENE has been used for many years as a source of light for farm homes, and it has given a high degree of satisfaction. The house is piped very much as for natural or artificial gas and a large-sized generator used. Recognizing the high quality of the acetylene flame, a few companies have attempted to build a table lamp. The accompanying figure shows one rather successful type. The carbide is contained in the upper chamber and the water in the lower chamber, it being a "carbide to water" feed. Granulated carbide is used. The stem of the automatic feed valve is seen just to the right of the burner tube.

A ¾-foot burner is used with this lamp, which burner generates 37-candle-power. Burners are designated by the number of cubic feet of gas consumed each hour. With carbide at four cents per pound and kerosene at 12 cents per gallon, the cost of operating an acetylene lamp is about 20 per cent more per candle-power-hour than for an ordinary round wick kerosene lamp. The flame of the acetylene lamp is so much better than the flame of a common kerosene lamp that the added cost is of small moment.

A table lamp that burns acetylene

A New Tractor Dynamometer

WITH the rapid development in tractors and tractor tools, there has come an increased demand for a machine capable of measuring the pull of the tractor and the draft of other implements. There has been a notable lack of experimental work done on the draft of farm machines and one reason for this condition has been the absence of suitable apparatus for performing the work. A new dynamometer has just been designed and put on the market by a company prominent for years in railway traction test work. The instrument is quite complete and bids fair to give a high degree of satisfaction.

This dynamometer makes use of the hydraulic principle, that is, the pull is measured by the degree of compression of a liquid contained within a cylinder. This idea is thought to be more reliable than the use of springs of one kind or another. The dynamometer proper, the part which measures the pull, is shown in Fig. 1. This is hitched between the motive power and the tool being tested. The clevis to the right is connected to the piston in the cylinder. Under a heavy pull there would be some leakage of oil (the liquid used) past the piston. A pump is shown at (2) which is used to return this oil to the cylinder. As the liquid is compressed the force is transmitted through a flexible tube connected to the cylinder at (1) to the recording apparatus Fig. 2.

A piston (4), by means of a system of levers, further transmits this compression to a pencil (5). This pencil plays over a sheet of paper carried on a large roll, motion of the paper being secured by means of a 24-inch wheel running upon the ground. In testing plows this wheel runs in the bottom of the furrow. The pen at (6) draws the zero or datum line and the distance between this line and the mark made by the pencil (5) gives a measure of the intensity of the pull.

In order to secure the average pull, it is necessary to obtain the area between the zero line and the line described by the moving pencil. This is done by the automatic integrater (7) which makes electrical contact through the relay (8) every square inch. The relay closes the circuit operating the pen (9) giving a record on the paper, which record is tallied by the counter (7), so that the total area of the curve may be secured instantly at any time during the test.

A time clock in connection with the recorder makes electrical contact every 10 seconds, thus operating pen (11) which gives a record on the paper at this interval. Pen (12) is operated by a push button and enables the operator to indicate at any time any portion of the curve which for various reasons should be excluded from the final calculations.

The results are easily calculated. The area record divided by the proper travel gives the average height of the indicator card in inches. If this is multiplied by the force necessary to produce a pencil movement of one inch and this by the ratio of the area of the dynamometer piston to the indicator piston, the mean pull in pounds is determined. Having the time record and the rate of travel, the horse-power developed is quickly determined. A continuous record of 5,000 feet can be made.

To prevent the delicate mechanism of the recording apparatus from accidental injury or from being clogged with dirt it is placed in a light metal case, as shown in one of the pictures. The machine can be carried by the convenient handles or may be placed upon the machine being tested. It has an aluminum base, which serves to decrease the weight materially.

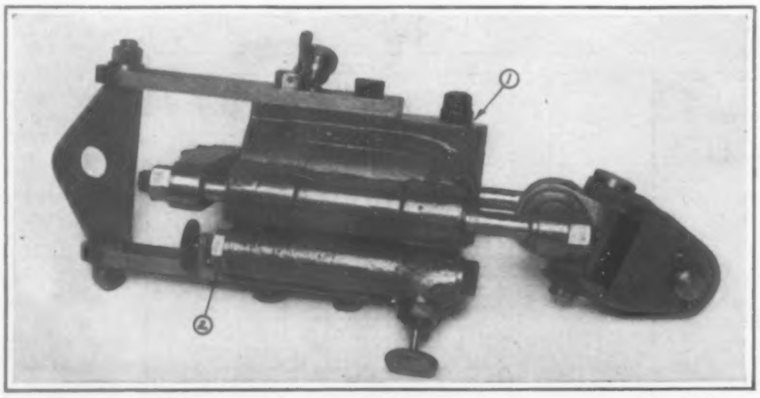


Fig. 1. The dynamometer proper which measures the amount of the pull

Sorghum as a Coloring Material

THE French technical press has lately been full of a very interesting communication made to the Academy of Sciences by M. Piedalu. It deals with the utilization of sorghum as a coloring material. The "glumes," or husks of sweet sorghum and those of sorghum with black seed, hitherto of no use at all, are found to yield a gum with very fine shades of color ranging from pink to bright red, salmon, scarlet, pearl gray, dark gray, dark brown and khaki all colors which, being sun and soap-proof are highly suitable for dyeing wool, silk, leather and vegetable fibers. The discovery of this new dyeing material, it is stated, is one of great importance, and steps are to be taken to work it on a large scale.

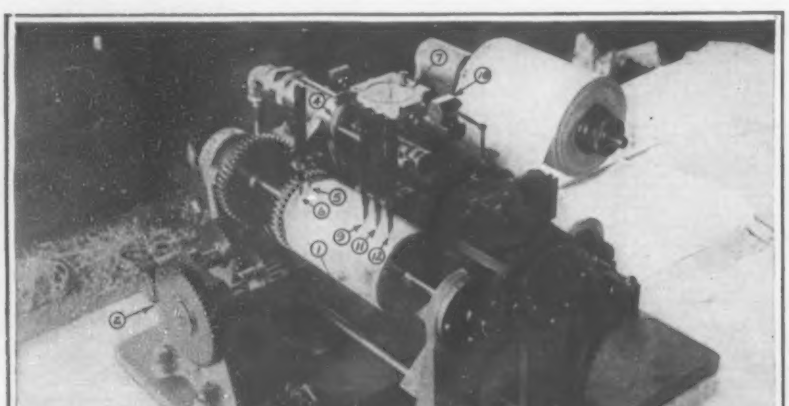


Fig. 2. The apparatus which records the pull

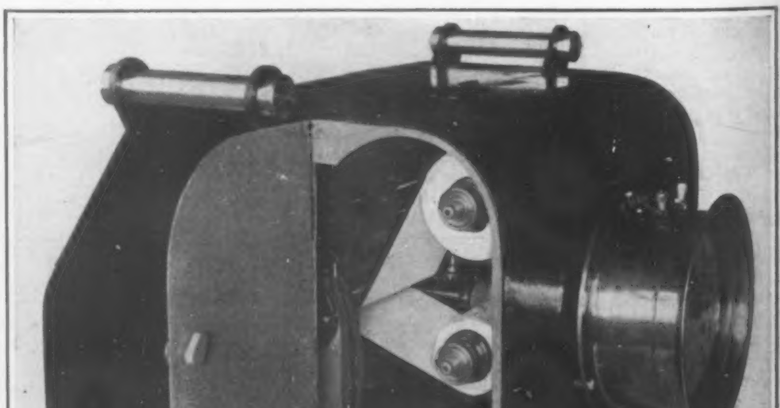
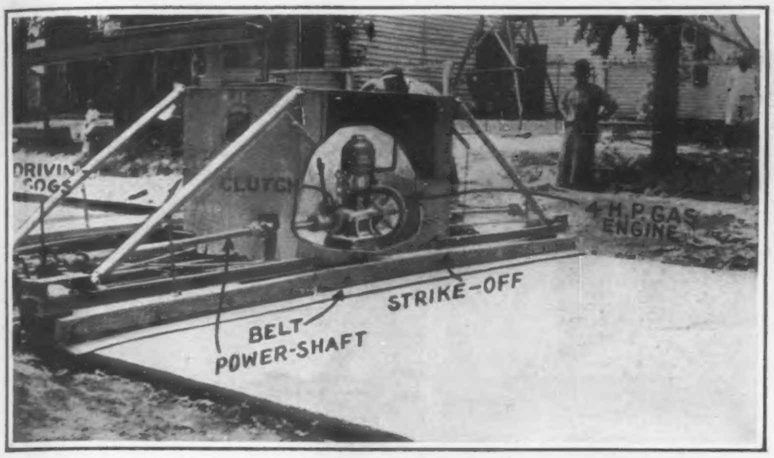


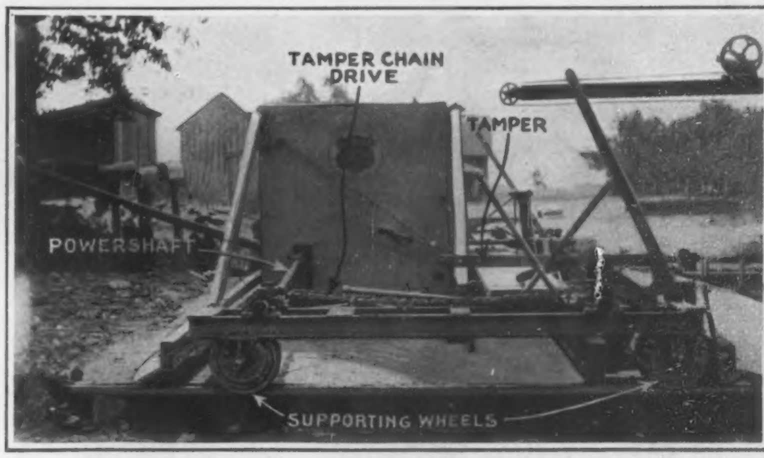
Fig. 3. The recording mechanism enclosed in a dirt-proof case

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts



The mechanism that distributes the mixture to the proper height and crown before tamping



The machine for finishing concrete roads, showing the operation of the tamper

A Mechanical Finisher for Concrete Roads

A MACHINE which will automatically strike off, tamp and finish the surface of a concrete road has recently been brought to a point of perfection by a Cleveland, Ohio, machinery company. It has been under development since 1913 on the roads in California and in its present form will do the work of more than a dozen men and do it so that the finished surface is mechanically perfect and free from laitance, silt or light particles which float to the top if the mix of cement is too wet. One of the chief advantages of the machine is its ability to finish the surface no matter what consistency of mix is considered to be the best for the particular work in hand. With hand-finishing it is always necessary to employ a slight excess of water, but this is detrimental because it reduces the strength of the concrete.

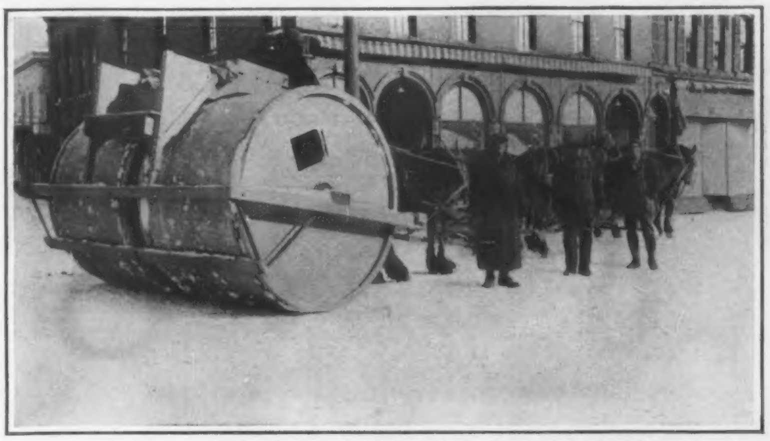
The apparatus consists of a metal frame work carrying a four-horsepower gasoline engine inside of a protecting sheet metal box in the center. The entire machine moves forward at the rate of seven feet per minute and backs up at the rate of 28 feet a minute by power secured from the gas engine and driving through a system of chains and sprockets to the four wheels on which the apparatus is carried.

The finishing operation is done in two separate steps and by two distinct parts of the machine, the tamper and the strike-off to which a belt float is also connected. The strike-off spreads the concrete to the necessary height and crown. The tamper, a paddle-like affair is located at the rear of the machine between the gasoline engine case and the strike-off board. The first time over, it tamps the concrete with a long, hard stroke. The length of the stroke may be regulated by the operator so that on the second time over, the concrete is subjected to a continuous agitation without exerting any pressure on the mixture. This tamping compacts the concrete and brings the air to the surface and tends to bond the stones with just the proper quantity of cement. The final finishing touch is done by the float, a belt attached to the strike-off and moved over the surface to smooth it off.

Making Smooth Hard Roads with a Snow Roller

ONE of the greatest obstacles to traffic in some of our northern towns is a heavy fall of snow, with no facilities for clearing it away. Under such circumstances vehicles simply flounder around until the ordinary traffic has packed it down. In at least one town, however, Laconia, N. H., this difficulty has been overcome by means of a heavy roller which hastens and systematizes the hardening process. It is the invention of Charles A. French, the city engineer of Laconia, and has been successfully employed for a number of winters.

The roller consists of two cylindrical wooden drums, each 6 feet 4 inches in diameter and 5 feet in length, mounted on an oak frame and surmounted by a seat and tool box. Thus the combined drums give a snow-compacting width of about 12 feet. In Laconia the device is used principally for breaking country roads and is sent out when there is a fall of four inches or even less when it has drifted.



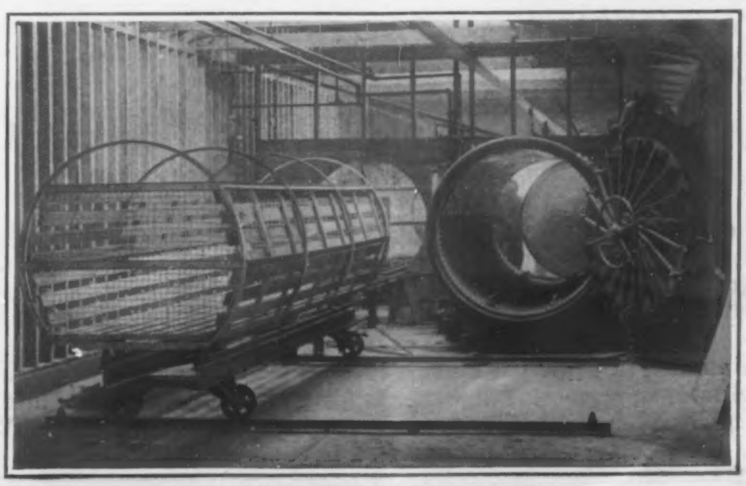
Don't remove the snow—pack it down hard and go sleigh-riding!

The roller is drawn by four or six horses and three or more men are required to operate it; one to drive the horses and the others to go ahead and shovel when heavy drifts are encountered. The shovelers also level sliding places and chuck-holes, and when the roller passes over it compacts the snow so that it will hold a team, and the roads need no more attention until the next storm. So hard is the snow packed down that in the spring, when the snow begins to thaw, some of the deeper drifts have to be cut out with a road-machine. In the city, after the sidewalks have been cleared by the snow plows, the ridge left at the edge of the sidewalk is spread over by means of the road-machine and then rolled by the snow-roller.

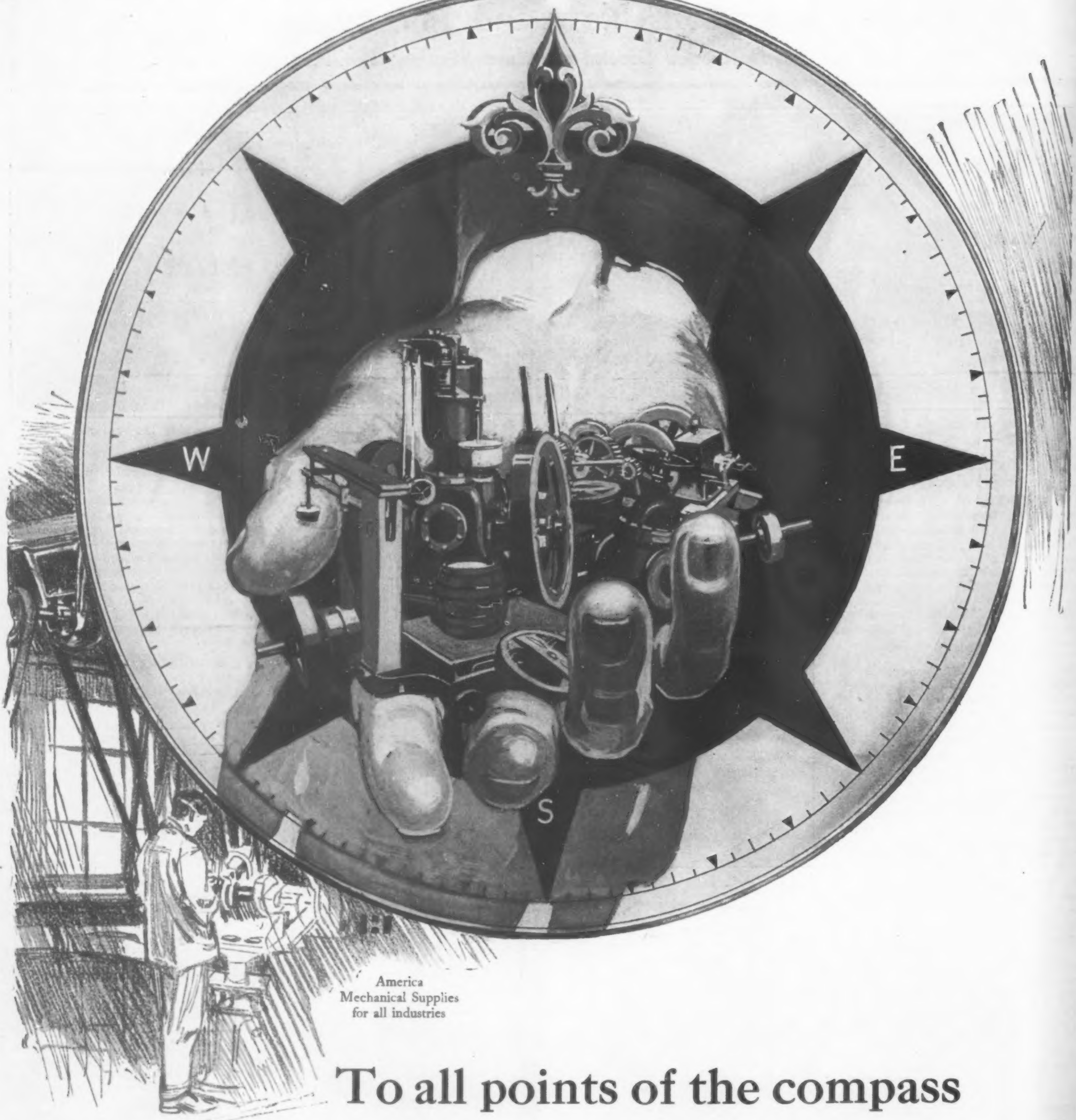
Eliminating the Cootie

THOUSANDS of *pediculi vestimenti* and more thousands of *pediculi capitis*, direct from the battlefields and trenches of Europe, are the prospective victims of the new delousing or cootie-killing plant established at Camp Devens as part of the Sanitary Process Plant. As thousands of soldiers will be demobilized during the next few months at Devens, including the entire 26th or Yankee Division of 26,000 men, there will be constant daily use for such an outfit. It is one of the most modern of the many inventions evolved by the experts of the United States Army, and better than the original crude affairs that were established in the early stages of the war in France, Germany, Russia and Serbia.

All returning soldiers from the transports that will dock in Boston will be sent to Camp Devens for demobilization after thorough quarantine, which includes the delousing process. Every soldier has to disrobe. His clothing and his belongings are all thrown into his barracks bag. The cooties get it either way, whether they insist on staying with the soldier or with his effects. With the former they will be scalded to death or drowned out, for the soldier has to undergo a hot shower bath with plenty of soap. With the clothing they will be scalded by live steam. The clothing and the effects in the barracks bags are thrown into a huge cylindrical wire basket, shown at the left of the picture. It accommodates 70 bags at a time. Once filled the basket is rolled to the death chamber, said chamber being a long steel tube connected up with pipe supplying live steam. The basket and its contents are sealed up inside the tube by huge steel doors and the steam is turned on for forty minutes. After this the basket is removed for the contents to cool. The bags full of clothing and other impedimenta of a soldier are delivered to him dry but still warm—slightly wrinkled and shrunken, perhaps, but clean.



The delousing plant at Camp Devens



To all points of the compass

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TRUCKS & WHEELBARROWS ~ ENGINES & PUMPS

Admiral Sims in the Team-Work for Victory

How the Admiral Stood Out for Consolidation as Against Mere Coöperation

It is not stretching a point too far to say that the greatest ally of Germany, during the first four years of the war, was the lack of a unified command among the Allied armies opposed to her. Admiral Sims has earned the lasting gratitude of the nation at large and his brother officers in particular, because he stood for the closest consolidation under single leadership, and not merely for simple cooperation with our Naval Allies. Only thus, as the event has proved, could the quick defeat of the submarine, the capture of the High Seas Fleet, and the transfer of 2,000,000 American troops to Europe have been accomplished.

FROM the very moment that Admiral Sims took command of our European Naval Forces in this war, he adopted a few outstanding policies which are typically characteristic of his methods, and which are largely responsible for the efficiency of our naval forces which operated with foreign navies with which they have come out of the war. The walls of secrecy that existed between all navies in time of peace, together with the typically American characteristics which existed in our own Navy, caused our Navy to develop methods and practices peculiar to itself, and at the same time, quite different from those existing in other navies.

It was natural, and quite to be expected, that when our ships were required to work as a team with foreign navies, these differences in methods and practices were suddenly thrown into the limelight. In the opinion of our own Navy, at least, a great many of these methods and practices were considered far superior to the methods and practices found in vogue in the foreign navies. It was also inevitable that a spirit of competition and rivalry should at once start to grow up. It was therefore to be expected, and was quite natural, that our officers should resist changing their own methods, and that all sorts of sources of friction should thereby arise. A marked tendency existed in the beginning to keep our ships separated from foreign ships, to give them areas to operate in by themselves, so that the work they did would be clearly contrasted with the work of other navies. In joint operations of navies, questions of pride and prestige are inevitable factors.

Admiral Sims' policies were aimed to cover all of the above, and many other points which always exist in allied joint operations and for which there naturally cannot be any previous training in time of peace. It is perhaps natural that his policies have been misconstrued by many who were not acquainted fully with the most unusual circumstances of such an unprecedented war.

At the very outset he clearly set forth that the one and only task confronting our ships was "*to defeat the enemy*"—"*to win the war,*" and that no other considerations were to be allowed to interfere with this one outstanding aim. Questions of pride, prestige, relative value of methods, etc., should be sacrificed to the above single aim. The watchword was to be "team-work." Wherever possible our ships and men were not only to coöperate with the foreign ships and men, but were to consolidate with them into "one team."

Except where absolutely necessary, our ships were not to build up duplicate administrative organizations, duplicate lines of communication, duplicate supply stations, etc. There was a natural tendency to build up our own separate supporting systems so that whatever "show" we entered into would be our own. The Admiral preached that the best way to "win the war" was to take conditions as we found them and work with them, thereby not only saving great and unnecessary expense, but also saving long delays which would be involved if we had to wait for this and that to be brought from home, let alone the unnecessary demands upon shipping which was really the vital factor in the war—to cut out growling—to get in the game with both feet.

The Admiral made it clear to his officers that their game was to avoid delay in hitting the enemy, and to stop at nothing no matter what they had come to believe in the past, which would diminish in any way their throwing their maximum weight into the scales without delay. In war, "time" means everything. Time is an all-important factor. Hit the other fellow first—the faster and quicker you defeat his game, the sooner the sacrifice of precious life, the waste and expense of war are over. Most earnestly he pointed out that it did not make any difference what our ships were doing, what ships they were protecting, or where they were working, as long as they were hitting the enemy to the best advantage in speeding the day of victory. As to differences in methods and practices of foreign services, the British service was the principal one concerned simply because it was by far the largest and hence the one with which our Navy naturally came in the most contact. He insisted that it be decided in general Allied council as to where our ships would be of the greatest service.

The Admiral constantly directed the point of view of his officers to the following inescapable facts: We were greatly outnumbered in ships, men, material and everything else in the game. In every phase the other fellow, who outnumbered us, had been at it for nearly three long years. In other words, we were entering a war in its last phase, not in the beginning. He never questioned but that many of our methods and practices were superior to the corresponding ones in the older navies. He pointed out that, as we were decidedly in the minority and the other fellow had settled down to his paces, it would only slow the game down and *help the enemy*, to attempt to force the other older navies to adopt our methods or to convert them to our views. The task of persuading the other navies to change their methods would simply involve lost motion and delay. The war was no time to try to educate or change the other fellow. Hence all of his officers were directed and encouraged, regardless of red tape and regulations, to unhesitatingly drop, for the time being, their own methods and practices, if by so doing delays and friction could be avoided, and the enemy hit the harder. Of course, 100 per cent efficiency could not be expected. Where we could work our methods in without confusion or delaying the game or causing friction—fine—go ahead.

Presentation of a parting gift to Admiral Sims in London

In other words, Admiral Sims' policy was, that in any game of coöperation, concessions must be made. All parties may be heard at the Council Table, but when it comes to action, one side must give way. This is the principle of unified command, later adopted on the Western Front, and incidentally it is the guiding principle of all successful enterprises in civil life.

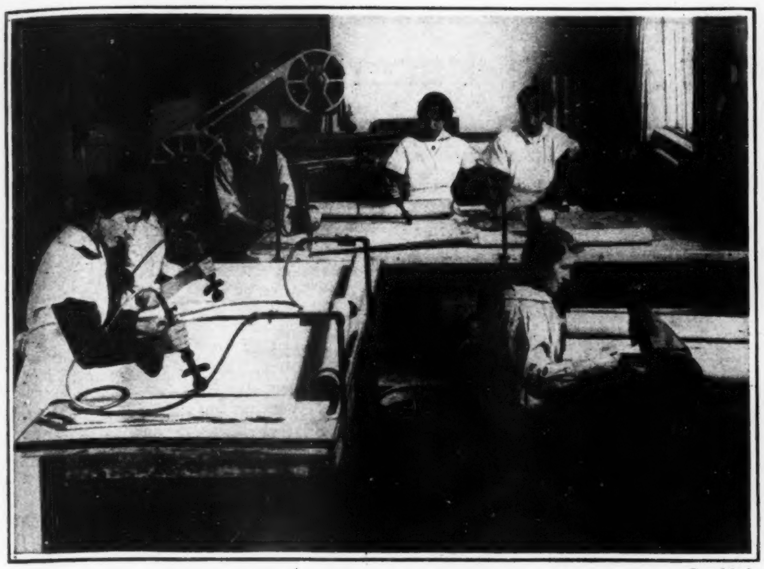
Admiral Sims preached a doctrine, easily misconstrued by those who did not fully understand—his doctrine was that as we were decidedly in the minority, we should be the quicker and show the greater willingness to give way in our arguments and contentions; and this for the good reason that our aim was not to prove our case, or to prove our superiority in this line or that line, but solely to defeat a common enemy. He repeatedly said, "Never mind about the credit, or prestige, or recognition, but get on with the war." It is difficult to explain but, nevertheless, only too true, that Admiral Sims' path, in ensuring that such policies as the above were carried out, was not strewn with roses. It would take a volume of no small size to chronicle the troubles that arose or tried to arise, or the obstacles which encumbered his path. From the moment he arrived in Europe, which was two days after the United States declared war, he stood out for the above policies in all of his work, not only with his own ships, officers and men, but also in his dealings with the heads and the organizations of foreign navies. In other words he at once adopted the policy of unified command, which latter attracted so much world attention when it was announced as being adopted by the armies in the field.

Admiral Sims took the stand in the Allied Council Chambers that his forces should be looked upon as "reserves" being brought up to the "front." That where they should go and in what numbers should be determined only after frank discussion by everyone concerned; and should be based only on the general and strategical situation, and with the sole end in view of winning the war. This policy is quite opposed to the one which natural inclination dictates. We had a navy which was a separate team in itself, with its own methods and its own traditions. It had been preparing for this day for many years. It was only human and natural impulse that it should resist being broken up and scattered. It naturally did not relish being mixed with detachments of the navies of other nations and being separated from its own traditions and methods. However, such were the conceptions of our principal naval commander in the war, and who can question the high motives and unselfishness which they typified.

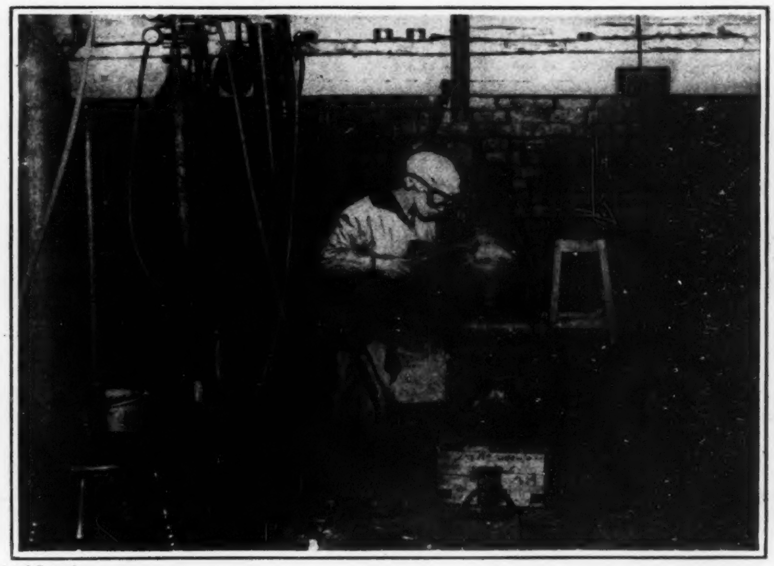
Results only count, and now that the war is over the fact cannot escape that our Navy in the war under the leadership of Admiral Sims, has come home with nothing but praise and admiration and respect from the foreign navies with which it has worked. Practically no word of criticism, either through official or unofficial channels has been heard. Admiral Sims himself in some quarters at home has been criticized, this being due to misinterpretations of his policies and methods. Fortunately, however, he is a big enough man not to allow these criticisms to interfere with his continuing to be governed by his own convictions based upon his experience.

As a result of the above, our naval ships were scattered throughout the war zone, for example, in the White Sea, the North Sea, with the British Grand Fleet, in the Irish Sea mixed with the British command, off the French Coast mixed with the French Command, Gibraltar, mixed with the British, the Adriatic, mixed with the Italians, and on shore it was found in aviation mixed with the British in Ireland and England, on the shores of the North Sea, in Flanders mixed with the French, Belgian and British, on the French Coast mixed entirely with the French, in Italy again mixed with the Italians. It was mixed principally with the British for one reason alone, and that was on account of the size of the British navy, which was scattered through all the areas above mentioned. It could not have been otherwise. In view of the size of Britain's navy it was natural that the French and the Italians should not have attempted to increase their navy or make up their losses during the war. Their attention was principally directed toward their armies.

(Continued on page 384)



In the army clothing factory—making stencils with electric and gas tools that perforate the paper to the required design



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Welding aerial bombs—a man's job done as a man would do it, by a woman with a man's heart

British Munitions

A Glimpse at a Picture Too Big for a Single Canvas

By C. H. Claudy, Special Correspondent of the SCIENTIFIC AMERICAN in London

HANGING on the wall of one of a thousand of England's Munition Offices is this quotation from Sir Walter Raleigh:

> "Whosoever in writing a modern history shall follow Truth too near the heels, it may haply strike out his teeth."

Written in 1614, it has lost none of its potency in 1919, especially to him who would attempt the impossible task of painting a true picture of Great Britain's munitions work in a single article. The present writer needs his teeth, if only to have something to hook into the next story, and so he feels that there may be some excuse if he does not follow "Truth too near the heels".

To get even a faint idea of the program it seems fairly obvious that one first envisage what "Munitions" means. If it means guns and shells, the answer is simple—the Ministry of Munitions will supply no figures until a peace treaty has been signed. If it means all war material, then the pages of one issue of the SCIENTIFIC AMERICAN could not hold the mere statistics if they were available.

The act establishing the Ministry of Munitions was passed on June 9th, 1915, and special powers were conferred upon the Minister of Munitions by an Order in Council dated June 16th, 1915, the Munitions of War act, 1915, and subsequent acts and the Defence of the Realm acts. Mr. Lloyd George took up his work as Minister of Munitions on May 26th, 1915, the nucleus of the new department being formed by the staff of the Cabinet Committee on Munitions together with that of the special organization established at the War Office under Lord Kitchener for the development of munition supply, known as the Armaments Output Committee.

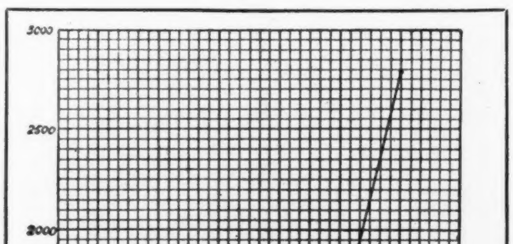
To these were rapidly added certain older sections of the War Office organization. This process of transfer from the War Office was carried further in later months, and by the end of 1915 the scope of the department covered the supply of arms, ammunition, explosives, optical munitions, materials, trench warfare supplies, munitions contracts, munitions finance, inspection, invention, design and the administration of the Royal Ordnance Factories, these functions being, in the main, duties which had formerly been exercised by the War Office.

During 1916 the Ministry of Munitions was entrusted with further responsibility for the storage of gun ammunition, supply of tanks, supply of tractors for heavy howitzers, supply of railway materials for the army, supply of mechanical transport vehicles, and the supply of chemical glass and laboratory ware.

Since December, 1916, these functions have been further extended to include the highly important department in charge of the supply of heavier-than-air aircraft for both land and naval services, as well as the development of agricultural machinery supply on behalf of the Board of Agriculture. Since June, 1917, the Ministry of Munitions has also been responsible for the supply of fuel oils.

It seems fairly obvious that to tell the story of such a department, needs not an article, but an encyclopedia! But perhaps if a few high spots are touched, the reader may gain some perspective on the size of the picture if not of its just proportions.

During the last four days of fighting before the armistice



Graph showing the increase in production of munitions by weight

For purposes of comparison the production in June, 1915, when the Ministry of Munitions was founded, is taken as 100

Great Britain's guns used up 12,500 tons of ammunition daily. Neither then, nor any time since the dark days of the German offensive, has Great Britain expended ammunition faster than it could be supplied. During that German offensive the English army lost in one week 1,000 guns—and less than a month later had 1,500 new ones to take their place. We are fond of talking about speed of production in the United States, but the Briton has certainly little to learn when an armed foe is menacing his island integrity and his pride is touched that a Hun can get at him overhead and undersea!

Few people have much of an idea as to just what a single round of ammunition really means from the manufacturing end. Quite apart from the obvious things, such as shell, case, explosive, etc., before a single round can be manufactured it is necessary to obtain and work up emery stone, cryolite, calcium carbide, magnesite, wolfram ore, acetone, carborundum, nickel, bauxite, nitrates, oil, cotton, antimony, and many other items from different countries. Forgings and castings must be supplied as well as brass rod and stampings, an infinity of machining operations must be done, along with the superintendence of equipments, the ordering of the machinery, the manufacture, distribution and supply and use of hundreds of gages, the assembling of ingredients from different works in appropriate centers, the calculation of the raw material, the arrangements for transport, and so forth.

Further to elaborate on the complication of shell and ammunition manufacture, consider a few figures for the inspection service which the factories in England possess, to see that what is turned out is as right as human care and ingenuity can make it.

In July, 1915, the staff of the Inspections Department consisted of 8,761 persons. In June, 1917, it consisted in England of nearly 40,000 with an additional staff in the United States of more than 8,000. Women are employed in every possible way. In March, 1916, they composed 28 per cent of the staff; in June, 1917, they composed 61 per cent, numbering 29,000, and they are employed on almost all operations except those in which special technical experience or physcial strength are required.

The work of inspection, is often very tedious and monotonous. When it is remembered that there are no fewer than 183,000,000 separate gaging operations for every million rounds of shell, it can easily be seen why it requires both many workers and great fidelity to accuracy in the work.

There are in Great Britain—or were at the time of the armistice—upwards of 20,000 factories engaged in munitions work exclusively. The vast majority of these, of course, were private factories, operated under strict Government control. The Ministry of Munitions has full and complete powers to help itself to any factory, take any labor, commandeer any machines or buildings that it needs—and it is only fair to say that this enormous power, perhaps greater than that possessed by ancient kings prior to Magna Charter, has been used with the single-minded desire to "win the war" and with a resulting friction and discontent so small, as to be a matter of amazement to the American observer, whose inalienable right it is to grumble at his government, even when most enthusiastically supporting it. Most important of the factories are the national factories. On the 31st of October,

(Continued on page 384)

Mechanical Equipment of the Farm

Latest developments in agricultural machinery and practical suggestions for the farmer

Conducted by HARRY C. RAMSOWER, Professor of Agricultural Engineering, Ohio State University

An Acetylene Table Lamp

ACETYLENE has been used for many years as a source of light for farm homes, and it has given a high degree of satisfaction. The house is piped very much as for natural or artificial gas and a large-sized generator used. Recognizing the high quality of the acetylene flame, a few companies have attempted to build a table lamp. The accompanying figure shows one rather successful type. The carbide is contained in the upper chamber and the water in the lower chamber, it being a "carbide to water" feed. Granulated carbide is used. The stem of the automatic feed valve is seen just to the right of the burner tube.

A ¾-foot burner is used with this lamp, which burner generates 37-candle-power. Burners are designated by the number of cubic feet of gas consumed each hour. With carbide at four cents per pound and kerosene at 12 cents per gallon, the cost of operating an acetylene lamp is about 20 per cent more per candle-power-hour than for an ordinary round wick kerosene lamp. The flame of the acetylene lamp is so much better than the flame of a common kerosene lamp that the added cost is of small moment.

A table lamp that burns acetylene

A New Tractor Dynamometer

WITH the rapid development in tractors and tractor tools, there has come an increased demand for a machine capable of measuring the pull of the tractor and the draft of other implements. There has been a notable lack of experimental work done on the draft of farm machines and one reason for this condition has been the absence of suitable apparatus for performing the work. A new dynamometer has just been designed and put on the market by a company prominent for years in railway traction test work. The instrument is quite complete and bids fair to give a high degree of satisfaction.

This dynamometer makes use of the hydraulic principle, that is, the pull is measured by the degree of compression of a liquid contained within a cylinder. This idea is thought to be more reliable than the use of springs of one kind or another. The dynamometer proper, the part which measures the pull, is shown in Fig. 1. This is hitched between the motive power and the tool being tested. The clevis to the right is connected to the piston in the cylinder. Under a heavy pull there would be some leakage of oil (the liquid used) past the piston. A pump is shown at (2) which is used to return this oil to the cylinder. As the liquid is compressed the force is transmitted through a flexible tube connected to the cylinder at (1) to the recording apparatus Fig. 2.

A piston (4), by means of a system of levers, further transmits this compression to a pencil (5). This pencil plays over a sheet of paper carried on a large roll, motion of the paper being secured by means of a 24-inch wheel running upon the ground. In testing plows this wheel runs in the bottom of the furrow. The pen at (6) draws the zero or datum line and the distance between this line and the mark made by the pencil (5) gives a measure of the intensity of the pull.

In order to secure the average pull, it is necessary to obtain the area between the zero line and the line described by the moving pencil. This is done by the automatic integrater (7) which makes electrical contact through the relay (8) every square inch. The relay closes the circuit operating the pen (9) giving a record on the paper, which record is tallied by the counter (7), so that the total area of the curve may be secured instantly at any time during the test.

A time clock in connection with the recorder makes electrical contact every 10 seconds, thus operating pen (11) which gives a record on the paper at this interval. Pen (12) is operated by a push button and enables the operator to indicate at any time any portion of the curve which for various reasons should be excluded from the final calculations.

The results are easily calculated. The area record divided by the proper travel gives the average height of the indicator card in inches. If this is multiplied by the force necessary to produce a pencil movement of one inch and this by the ratio of the area of the dynamometer piston to the indicator piston, the mean pull in pounds is determined. Having the time record and the rate of travel, the horse-power developed is quickly determined. A continuous record of 5,000 feet can be made.

To prevent the delicate mechanism of the recording apparatus from accidental injury or from being clogged with dirt it is placed in a light metal case, as shown in one of the pictures. The machine can be carried by the convenient handles or may be placed upon the machine being tested. It has an aluminum base, which serves to decrease the weight materially.

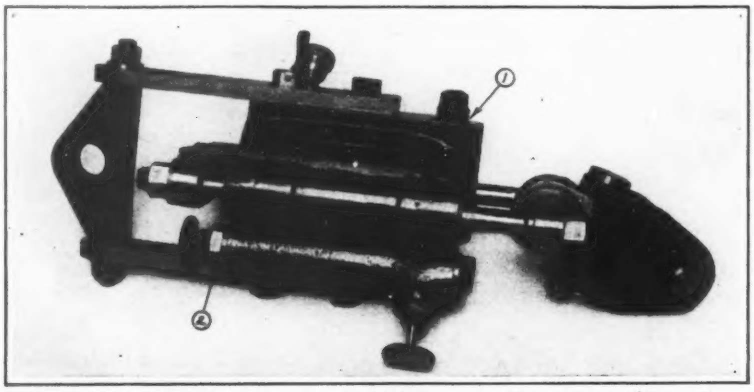


Fig. 1. The dynamometer proper which measures the amount of the pull

Sorghum as a Coloring Material

THE French technical press has lately been full of a very interesting communication made to the Academy of Sciences by M. Piedalu. It deals with the utilization of sorghum as a coloring material. The "glumes," or husks of sweet sorghum and those of sorghum with black seed, hitherto of no use at all, are found to yield a gum with very fine shades of color ranging from pink to bright red, salmon, scarlet, pearl gray, dark gray, dark brown and khaki all colors which, being sun and soap-proof are highly suitable for dyeing wool, silk, leather and vegetable fibers. The discovery of this new dyeing material, it is stated, is one of great importance, and steps are to be taken to work it on a large scale.

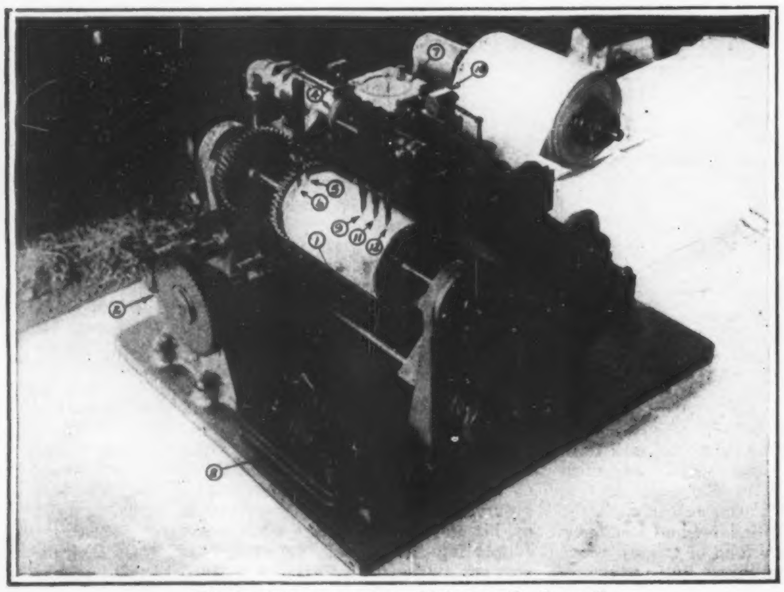


Fig. 2. The apparatus which records the pull

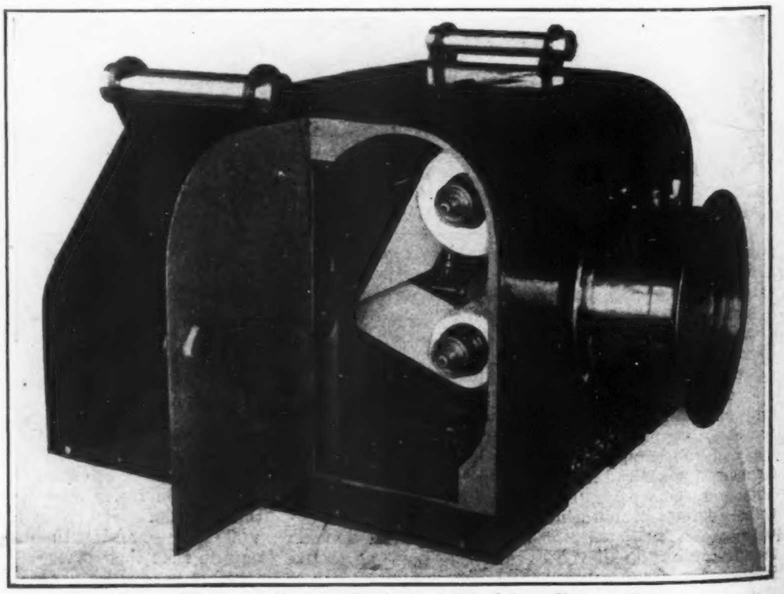
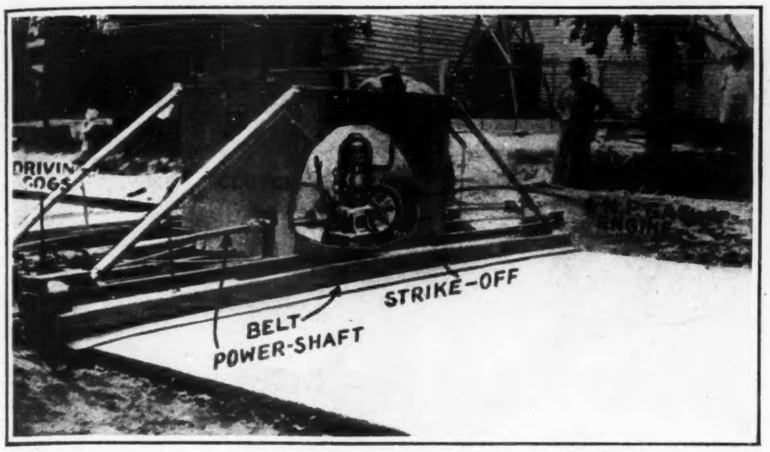


Fig. 3. The recording mechanism enclosed in a dirt-proof case

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts



The mechanism that distributes the mixture to the proper height and crown before tamping

The machine for finishing concrete roads, showing the operation of the tamper

A Mechanical Finisher for Concrete Roads

A MACHINE which will automatically strike off, tamp and finish the surface of a concrete road has recently been brought to a point of perfection by a Cleveland, Ohio, machinery company. It has been under development since 1913 on the roads in California and in its present form will do the work of more than a dozen men and do it so that the finished surface is mechanically perfect and free from laitance, silt or light particles which float to the top if the mix of cement is too wet. One of the chief advantages of the machine is its ability to finish the surface no matter what consistency of mix is considered to be the best for the particular work in hand. With hand-finishing it is always necessary to employ a slight excess of water, but this is detrimental because it reduces the strength of the concrete.

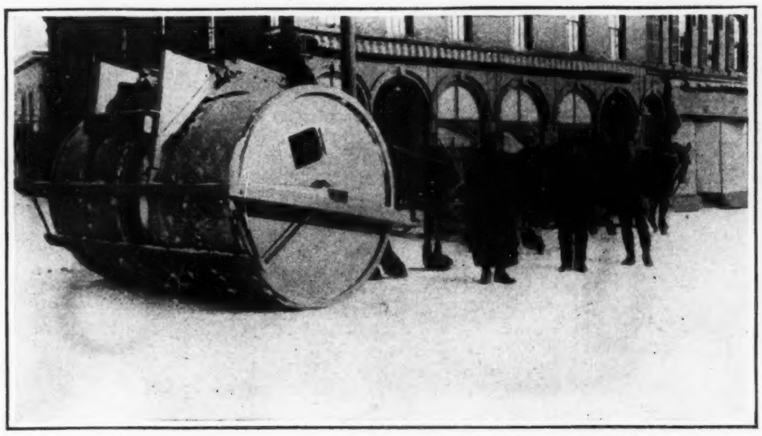
The apparatus consists of a metal frame work carrying a four-horsepower gasoline engine inside of a protecting sheet metal box in the center. The entire machine moves forward at the rate of seven feet per minute and backs up at the rate of 28 feet a minute by power secured from the gas engine and driving through a system of chains and sprockets to the four wheels on which the apparatus is carried.

The finishing operation is done in two separate steps and by two distinct parts of the machine, the tamper and the strike-off to which a belt float is also connected. The strike-off spreads the concrete to the necessary height and crown. The tamper, a paddle-like affair is located at the rear of the machine between the gasoline engine case and the strike-off board. The first time over, it tamps the concrete with a long, hard stroke. The length of the stroke may be regulated by the operator so that on the second time over, the concrete is subjected to a continuous agitation without exerting any pressure on the mixture. This tamping compacts the concrete and brings the air to the surface and tends to bond the stones with just the proper quantity of cement. The final finishing touch is done by the float, a belt attached to the strike-off and moved over the surface to smooth it off.

Making Smooth Hard Roads with a Snow Roller

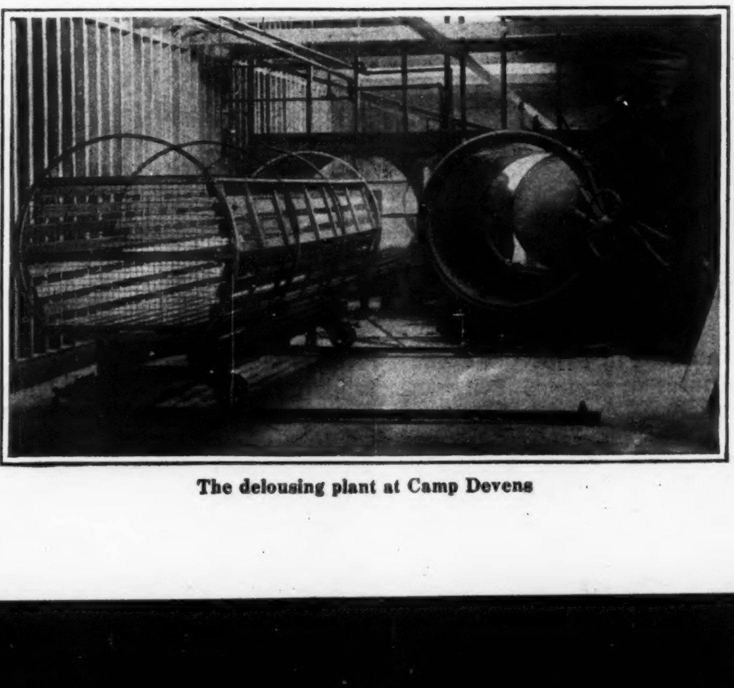
ONE of the greatest obstacles to traffic in some of our northern towns is a heavy fall of snow, with no facilities for clearing it away. Under such circumstances vehicles simply 'flounder' around until the ordinary traffic has packed it down. In at least one town, however, Laconia, N. H., this difficulty has been overcome by means of a heavy roller which hastens and systematizes the hardening process. It is the invention of Charles A. French, the city engineer of Laconia, and has been successfully employed for a number of winters.

The roller consists of two cylindrical wooden drums, each 6 feet 4 inches in diameter and 5 feet in length, mounted on an oak frame and surmounted by a seat and tool box. Thus the combined drums give a snow-compacting width of about 12 feet. In Laconia the device is used principally for breaking country roads and is sent out when there is a fall of four inches or even less when it has drifted.



Don't remove the snow—pack it down hard and go sleigh-riding!

The roller is drawn by four or six horses and three or more men are required to operate it; one to drive the horses and the others to go ahead and shovel when heavy drifts are encountered. The shovelers also level sliding places and chuck-holes, and when the roller passes over it compacts the snow so that it will hold a team, and the roads need no more attention until the next storm. So hard is the snow-packed down that in the spring, when the snow begins to thaw, some of the deeper drifts have to be cut out with a road-machine. In the city, after the sidewalks have been cleared by the snow plows, the ridge left at the edge of the sidewalk is spread over by means of the road-machine and then rolled by the snow-roller.

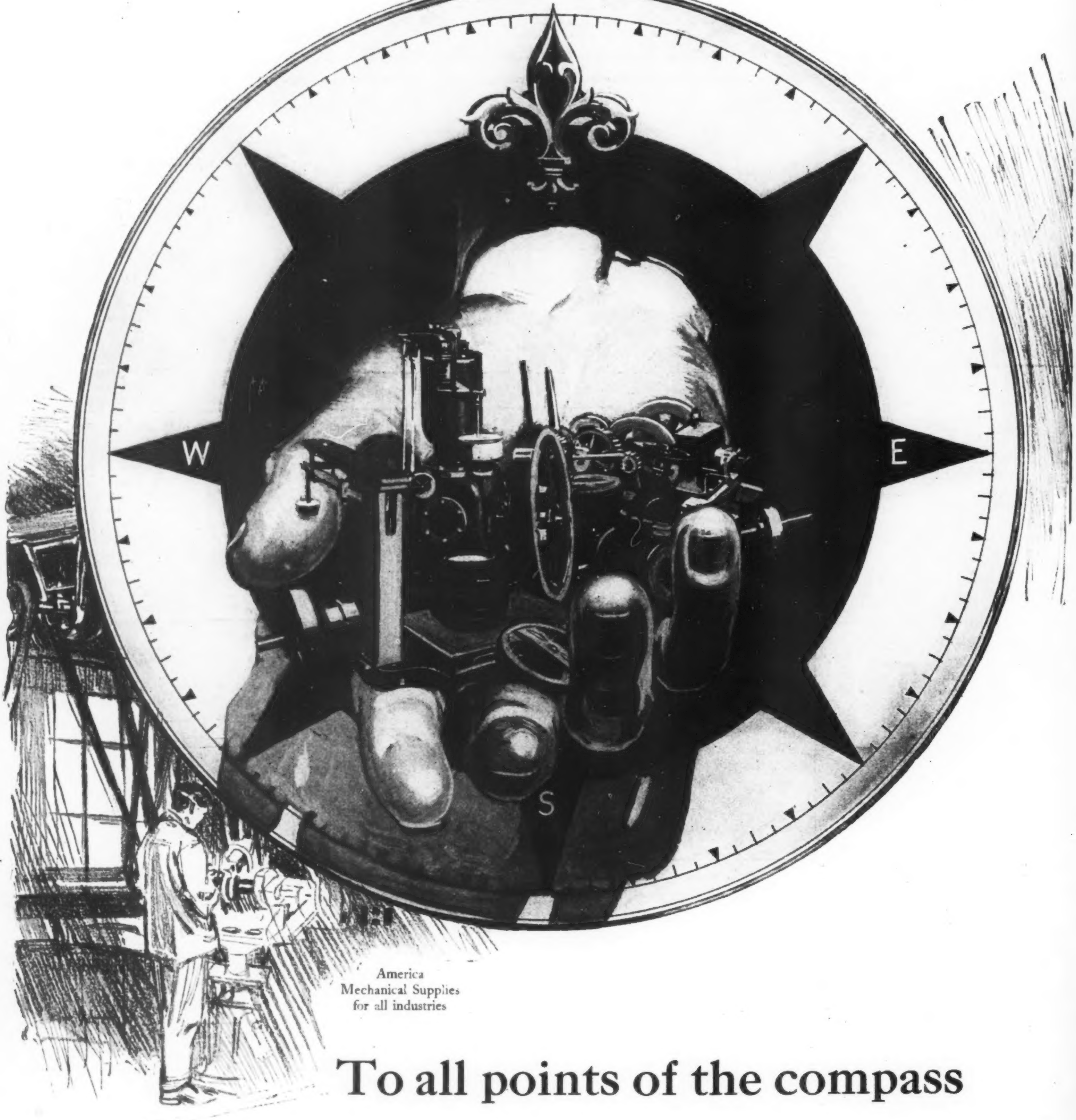


The delousing plant at Camp Devens

Eliminating the Cootie

THOUSANDS of *pediculi vestimenti* and more thousands of *pediculi capitis*, direct from the battlefields and trenches of Europe, are the prospective victims of the new delousing or cootie-killing plant established at Camp Devens as part of the Sanitary Process Plant. As thousands of soldiers will be demobilized during the next few months at Devens, including the entire 26th or Yankee Division of 26,000 men, there will be constant daily use for such an outfit. It is one of the most modern of the many inventions evolved by the experts of the United States Army, and better than the original crude affairs that were established in the early stages of the war in France, Germany, Russia and Serbia.

All returning soldiers from the transports that will dock in Boston will be sent to Camp Devens for demobilization after thorough quarantine, which includes the delousing process. Every soldier has to disrobe. His clothing and his belongings are all thrown into his barracks bag. The cooties get it either way, whether they insist on staying with the soldier or with his effects. With the former they will be scalded to death or drowned out, for the soldier has to undergo a hot shower bath with plenty of soap. With the clothing they will be scalded by live steam. The clothing and the effects in the barracks bags are thrown into a huge cylindrical wire basket, shown at the left of the picture. It accommodates 70 bags at a time. Once filled the basket is rolled to the death chamber, said chamber being a long steel tube connected up with pipe supplying live steam. The basket and its contents are sealed up inside the tube by huge steel doors and the steam is turned on for forty minutes. After this the basket is removed for the contents to cool. The bags full of clothing and other impedimenta of a soldier are delivered to him dry but still warm—slightly wrinkled and shrunken, perhaps, but clean.



To all points of the compass

FOR many years The Fairbanks Company has satisfactorily served Purchasing Departments in the entire industrial field—such purchasers as mills, factories, mines, railroads and steamship lines.

Branch Houses are maintained in principal cities. In each of these Branch Houses an immense range of products, together with efficient auto truck service, insures prompt deliveries. The individual Branches have complete facilities for any needed after-service.

No similar house has won the world-wide standing enjoyed by The Fairbanks Company.

* * *

MOST people know Fairbanks Scales. But it is not generally understood that The Fairbanks Company also markets Mill Supplies, Valves, Machine Tools,

MILL SUPPLIES ~ SCALES ~ VALVES ~ MACHINE TOOLS ~ TRANSMISSION

Transmission, Trucks and Wheelbarrows, Engines and Pumps, and other mechanical products of a quality which entitles them to bear The Fairbanks Company O. K.

To carry on this work, The Fairbanks Company, as stated above, now maintains 22 Branch Houses in leading American cities. Here business is done both at wholesale and retail. In addition, prominent dealers in other cities handle many of the Fairbanks products.

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The Fairbanks Company maintains a staff of experienced buyers who give our customers the benefit of volume buying. A force of 400 traveling salesmen, trained in mechanical lines, adds to the service.

PURCHASING agents buy in two ways: Orders may be scattered among many sources of supply, or the buyer may find all or a large part of his requirements met by The Fairbanks Company.

In centralizing his buying with The Fairbanks Company, the purchasing agent is in effect dealing with a Mechanical Supplies Department Store. He orders all he needs from one house. All items are put on one bill and delivered nearly always in one shipment. Thus complications are taken out of buying, bookkeeping and handling.

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Newark	Utica
New Orleans	Washington

Havana, Cuba
London, England
Glasgow, Scotland
Paris, France

The
FAIRBANKS
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O.K.

TRUCKS & WHEELBARROWS ENGINES & PUMPS

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

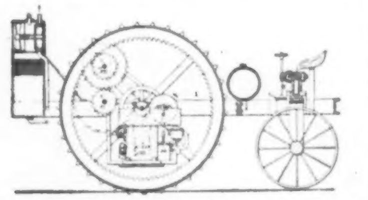
Pertaining to Apparel

SKIRT MARKER.—J. C. KOTTMAN, 1629 George St., Brooklyn, N. Y. The object of the invention is to provide a skirt marker arranged to enable a person wearing the skirt to readily mark the latter with a circumferential row of marks a predetermined distance from the floor to obtain the desired length of the skirt. Another object is to enable the user to provide the skirt with a second circumferential row of marks a distance below the first row of marks for indicating the width of a hem.

Of Interest to Farmers

TRACTOR.—S. A. THORNTON, 700 Nashville Ave., New Orleans, La. This invention relates to a tractor for drawing farm implements or vehicles, the general objects are to provide a construction of machines so designed that a farm implement, vehicle or other load can be hitched thereto in such manner that the tractor takes the place of one or more draft animals with the possibility of making short turns and taking up no more space than the animal or animals.

TRACTOR.—R. PETERSON, Rosalind, Alberta, Can. This invention has for its object to provide a tractor having a drive wheel within which a motor is disposed, the fuel for the motor as well



SECTIONAL ELEVATION LOOKING AT ONE SIDE OF THE TRACTOR

as the motor-controlling means, being led through the hubs of the drive wheel. Another object is to provide a radiator for cooling the water in the water jacket, and having a fan which is rotated by a turbine driven by the exhaust from the motor.

SEPARATOR.—H. B. LINDSLEY, Box 85, Sleepy Eye, Minn. The object of the invention is to provide a device especially designed for separating wild peas from wheat and the like, wherein an endless moving apron is provided, arranged in inclined position, upon which grain with the peas is poured, another apron being arranged in horizontal position for receiving the wheat, while a deflector is arranged at the outer side of the last named apron for deflecting the peas as they roll down the first named apron.

HAY RAKE.—W. R. BUTNER, Yerington, Nev., care of Antelope Valley Land and Cattle Co. The invention relates to hay rakes that dump by a revolving movement. An object is to provide a wheeled or riding rake in which the rake dumps by revolving movement and is manually controlled by the driver to position the rake for raking or for causing it to be dumped automatically, also to effect the operation and control of the rake without gearing or complicated connections liable to get out of order.

Of General Interest

DIRECTION INDICATOR.—C. L. POOR, 35 Thomas St., New York, N. Y. This invention relates to aerial and marine navigation, its object is to provide a direction indicator more especially designed to enable a navigator to keep a vessel on a spiral course known as a "search curve," or on any portion of such course, or upon an irregular broken course composed of sections of such spiral curve. Another object is to automatically correct the indication of the course of the vessel for the deviation of the compass on all points of sailing.

METHOD OF PREPARATION OF ARTIFICIAL PEARLS AND JEWELRY.—K. MURAKAMI, 220 Broadway, New York, N. Y. An object of the invention is the manufacture of artificial pearls and jewelry from crystalline lenses of the eyes of fishes or sea animals, which are almost the same as genuine pearls and jewelry. Further objects are to solidify the crystalline lenses by heating the same in presence of moisture and to give pearl-like color to the crystalline by means of sulfid of lead and the white precipitates of insoluble lead salt produced within the crystalline lenses by chemical treatment.

PROCESS OF PRESERVING FISH, FOWL, AND FLESH.—L. W. MANUEL, address L. W. Baldwin, 311 Law Exchange, Jacksonville, Fla. The object of the invention is to produce a preservative by the use of salt and onion juice which when utilized for the preservation of fish, fowl and flesh minimizes the amount of salt required, and which while effectively maintaining the article in a condition suitable for food for any length of time, will at the same time retain in a large degree the natural flavor and do away entirely with any smoky or excessive salty flavor.

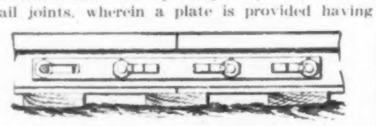
BABY CARRIAGE SEAT.—W. H. KOSTER, 711 Knickerbocker Ave., Brooklyn, N. Y. The invention relates to attachments for baby carriages, particularly to an extra seat which may be adjustably connected with the front of a carriage without molesting the occupant of the carriage. An object is to provide a seat which may be connected with any part of the carriage and supported partly by the bottom, to present a proper support without injuring the carriage.

WINDOW CLEANING APPARATUS.—R. R. BRUCKNER and L. BEMELMANS, address L. Bemelmans, 570 W. 182d St., New York, N. Y. Among the objects which the invention has in view are, to lessen the labor in cleaning windows, to avoid the necessity of the washer assuming a position outside the window, to provide means for removing the soil in the corners of the windows, to provide means for automatically regulating the pressure on the window panes, and to provide means for rapidly securing the washing element to the apparatus.

RECEPTACLE.—C. W. BOGERT, 1131 Hancock St., Brooklyn, N. Y. This inventor has been granted two patents; among the principal objects of these inventions are to provide a receptacle adapted for the transportation of liquids, to strengthen the construction with reinforcing sections to prevent crushing, to prevent leakage and to simplify and cheapen the construction. The receptacle is composed of a plurality of layers, plies or laminations, the outer ply being slightly larger than the inner ply, so that they may be turned over to form a binding edge, supplied with an adhesive coating. Suitable covers are formed also from layers or laminations. The receptacle may be varied to form a cup, bottle or ball-like body.

Hardware and Tools

NUT LOCK.—C. D. SWANN, Mogollon, New Mexico. This invention has for its object to provide a nut lock especially adapted for use in rail joints, wherein a plate is provided having



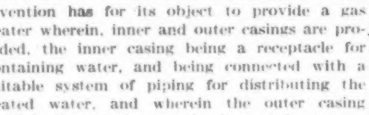
SIDE VIEW OF A RAIL JOINT PROVIDED WITH THE LOCK

openings through which the bolts may pass, and having means in connection therewith for engaging all the nuts to prevent their being accidentally loosened.

Heating and Lighting

COMBINED HOT-WATER AND HOT-AIR HEATER.—L. S. ROBERTS, Leechburg, Pa. The invention has for its object to provide a gas heater wherein, inner and outer casings are provided, the inner casing being a receptacle for containing water, and being connected with a suitable system of piping for distributing the heated water, and wherein the outer casing which incloses the inner casing is an air heater.

DRAFT GAGE.—R. E. THOMPSON, Deming, New Mexico. The invention has for its object to provide a gage especially adapted for use with a furnace or other heater, for indicating the pres-



A FRONT VIEW OF THE GAGE

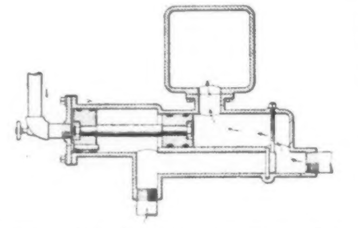
sure in the combustion chamber and in the stack, to permit the fire to be regulated to maintain a given reading on the scale of the gage.

Machines and Mechanical Devices

SHAFT BEARING.—W. C. SOLE, 114 No. French St., Sullivan, Ind. The invention has for its object to provide a bearing which may be moved as may be desired to adjust a shaft journaled therein. The shaft is journaled in a bearing member pivoted to a ring having studs disposed at an angle to the axis of the pivot, the studs being movable longitudinally in bearings by means provided.

BROOM MAKING MACHINE.—H. J. EDLUND, care of E. B. and A. C. Whiting Co., Burlington, Vt. An object of this invention is to provide a construction and arrangement of parts whereby there will be successive stages of operation being done simultaneously, the steps or times of movement being evenly divided, whereby an even continuous output is provided for. Another object is to provide for automatically clamping, shaping and riveting the brooms after the parts have been substantially properly arranged in position manually. A further object is an arrangement of parts whereby the moving elements are driven from a single power member.

AUTOMATIC BLOW-OFF DEVICE.—F. R. DEXTER, care of Hotel Caples, 350 Taylor St., Portland, Ore. The object of this invention is to provide an attachment for a steam boiler whereby any deposits of sediment, scale, sand,



A VERTICAL LONGITUDINAL SECTION OF THE DEVICE

grit or other solid particles may be discharged from within the boiler by means operated automatically at any desired rate of speed by reason of the internal pressure, as a result of certain adjustments either the whole contents or regulatable quantities may be discharged.

LUBRICATOR.—A. L. MAPSON, Granada, Minn. The invention has for its object to provide a lubricator especially adapted for use with wind mills, for lubricating the parts thereof, and controlled by the movement of the vane into and out of operative position to supply the lubricant; means is also provided for indicating when the lubricant is exhausted.

ADJUSTABLE BUSHING.—D. O. BARRETT, 1021 Rice Ave., Lima, Ohio. This invention relates to bushings for shafts and the like and has for an object the provision of a construction whereby the shaft may be adjusted by the adjustment of the bushing. Another object is to provide a solid bushing arranged with a shaft receiving opening offset in a manner that by turning the bushing to a different position a different alinement of the shaft carried thereby may be secured.

Medical Devices

COMBINED TISSUE AND NEEDLE EXTRACTING FORCEPS.—W. L. GRAY, Champaign, Ill. The object of the invention is to provide forceps adapted for surgical use, wherein the forceps have means for grasping the tissue to draw it together, and other means for clamping the needle to permit the same to be withdrawn, the grasping means and the clamping means being simultaneously controlled.

TWEEZERS FOR SURGICAL OPERATIONS.—C. F. LOGEMAN, Somerset West, Near Cape Town, South Africa. The invention relates to tweezers more particularly designed for use in surgical operations. The object particularly being to provide a means adapted to employ the vacuum principle to draw a ligament, membrane or the like to the tweezers to be gripped by the latter.

Prime Movers and Their Accessories

GAS AND AIR MIXING VALVE.—D. O. BARRETT, 1021 Rice Ave., Lima, Ohio. The invention relates to valvesfor internal combustion engines for the two-stroke cycle type, and has for an object the provision of an air and gas mixing valve which will provide a properly proportional and thoroughly mixed supply of air and gas during the continuous running of the engine; the device may be bolted directly to the engine bed or cylinder and receive the air from the bed or any outside source and then mix the same with the predetermined quantity of gas.

INTERNAL COMBUSTION TURBINE.—C. E. LANG, 878 Eddy St., San Francisco, Cal. The object of this invention is to provide a device wherein a separate combustion chamber is provided in which a steady high pressure is maintained during the working of the turbine, and wherein the fuel is admitted continuously, and it is possible to utilize the cheaper fuels as heavy or crude oil, and wherein the heat of radiation from the combustion chamber is utilized to perform useful labor.

Railways and Their Accessories

RAILWAY ROLLING-STOCK AND APPURTENANCES THERETO.—W. H. DIDLAKE, Box 121, Crystal Springs, Miss. The special object of the invention is the provision of means which will permit of more ready movements of car trucks with respect to car bodies, and through greater ranges of movement, than is now possible with the trucks directly supported by the car bodies. A further object is the provision of means to reduce friction between wheels and rails in use, and promote more comfortable travel, with materially reduced wear.

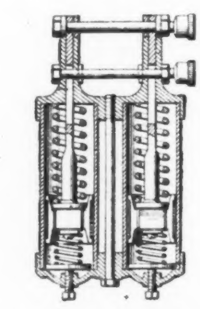
Pertaining to Recreation

AMUSEMENT RIDING DEVICE.—A. FELTMAN, care of Feltman Bros., Coney Island, N. Y. This invention relates to pleasure apparatus and has particular reference to amusement devices of the general nature of carousels or merry-go-rounds; it has particular reference to a device in or upon which a number of persons may be carried through any regular or serpentine path having a plurality of bumps or projections and over which base there is rotated a disklike carrier around the center of the apparatus.

Pertaining to Vehicles

VEHICLE FENDER.—C. LIBERMAN, address Herman J. Cutler, 1345 Fifth Ave., New York, N. Y. The object of the invention is to provide a fender for automobiles street cars, and other vehicles, arranged to normally clear ordinary obstacles in the roadway and adapted to swing downward into catching position on striking a person, with a view to pick up and safely retain person and to automatically stop the vehicle.

SHOCK-ABSORBER.—Address Inventor, Box 353, Gadsden, Ala. The invention has for its object to provide mechanism capable of application to motor vehicles of every character, for cushioning the upward movement of the vehicle with respect to the body and for cushioning



A SECTIONAL VIEW OF ONE FORM OF THE SHOCK ABSORBER

the recoil. The shock absorber comprises cylinders, wedge shaped plungers therein, expander blocks with which the plungers cooperate, springs normally forcing the plungers in a direction to expand the blocks, and means for retarding the movement.

AXLE.—G. E. THOMAS, 938 Wheaton St., Savannah, Ga. The object of this invention is to provide an axle consisting of inner and outer sections rotatable with respect to each other, the wheels being secured to the respective sections of the axle to permit a differential movement of the wheels while at the same time a strong and rigid axle is provided.

Designs

DESIGN FOR A LACE MEDALLION.—L. DREIFUSS, care of Horwitz and Rossten, 115 Broadway, New York, N. Y. The inventor has been granted two patents, one including the head of a soldier, the other the head of a sailor.

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The Current Supplement

EVERYBODY of normal vision must often have reviewed in his mind the so-called seven fundamental colors of the spectrum, and wondered what in the world indigo was doing in the list. In view of the undoubted fact that the average human being sees nothing between the blue and the violet which can fairly rank as an independent color, nothing more marked than the gradual shading from blue into violet that corresponds to the transition between each pair of primary colors, the question is indeed a pertinent one. A highly reasonable answer to it, and to other queries which the work of the great Newton inspires, will be found in the SCIENTIFIC AMERICAN SUPPLEMENT for the current week, No. 2258, for April 12th, under the title *Newton and the Colors of the Spectrum*. A point of some importance to the comparative philologist, and to the student of the human races in general, is the discussion of *The Antiquity of the Tamil speech* of Ceylon and southern India. An article that will appeal to the nature lover is *Insect Tyrants*, giving an account of observations made on the army ant of Guiana, with two very attractive photographs. A somewhat kindred subject is covered in *The Louse that Annoys Armies Abroad and People at Home*. Much valuable data is compressed into small space in *The Marine Diesel Oil Engine*. A series of attractive views, including a large cover picture, is presented of *Salvage Work in New York Harbor*, a field in which the wrecker finds far more employment that one might suppose. *High Temperatures in Engineering* is a contribution in a field of much importance in the present and future. *The Dustfall of March, 1918*, embodies the official findings as to the cause of the deposit, from the atmosphere, of some millions of tons of fine material over the northern and northeastern states within a few hours. *How the Latent Image on Photographic Plates is Developed* sets forth a new theory of the process, as developed by a French authority. The article, *Radium and Radio-Activity*, is completed in a third installment, and there are other short items of interest in various fields.

The Biggest Car Dumper in the World

(*Continued from page 363*)

transfer their weight to the vertical part of the cradle. It was necessary, therefore, to cut the platform in two.

The overturning of a big loaded car in a modern American dumper is an interesting thing mechanically. The platform and cradle, together with the car, are to be turned through an angle almost equal to 180 degrees. It is not proposed to let anything slip except the coal. Accordingly, the arrangements will need to be such as to hold the car squarely against its track with enough force to hold car and movable platform securely in place. There are several steel construction concerns which build dumpers, so that naturally there will be variations in minor points. In a representative case, the procedure will conform substantially to the following account.

The lifting and overturning of the L-shaped cradle is accomplished by means of wire hositing-ropes, more or less counter-weighted. The retention of the car and platform is also accomplished by means of ropes suitably counterweighted. This second group of ropes will number, say, four in an ordinary big installation. At Sewell's Point, the big two-car dumper has eight, four to each car. The rope retaining car and platform do not come in action for this purpose until the overturn begins. Nor do they ever come into actual contact with the car. A loose clamp is interposed, consisting mainly of a bar which stretches across the top of the car and bears with its under side against the edges. Above, this bar is grooved to receive the rope. The latter is held by its counterweight with sufficient force to hold car and platform in place, but not with sufficient force to prevent the overturn. With four clamps and four ropes, distributed at suitable intervals along a car, the resistance provided takes care of the whole length of car. Naturally, as the loaded car is overturned and in consequence leans more and more out of the dumper tower, the ropes yield and belly out; but the counterweights keep them sternly to their duty. The clamps and ropes interfere inappreciably with the discharge of the coal.

The clamps themselves are simple affairs. There is the crossbar already mentioned. On one end is a long rod set at right angles. When the loaded car is riding and the clamps are in position, these rods will extend vertically downward and pass loosely through holes arranged in the floor of the cradle. When the cradle returns with the empty car, the lower ends of these rods will encounter fixed rests. The effect then is that the car goes on down and leaves the clamps standing in a row with their horizontal arms at a suitable distance above the car and extending well over its top.

As the loaded car goes up, it meets the clamps and carries them along into position to receive the corresponding ropes when the overturn begins. The ropes lifting the cradle bring it up against a resistance which turns out to be in effect a pivot at each end of the cradle. As the ropes continue their action, their pull is, by the pivots, converted into an overturning movement.

At Sewell's Point, the deck of the pier is about 70 feet above the water, this great elevation being necessary to provide for the gravity discharge of coal from pockets or bunkers arranged beneath the car tracks on the deck. So tall a pier made it necessary to provide for getting the coal to the deck in some kind of rolling stock. Special pier cars of 120 tons capacity—the largest cars of the kind in existence—are provided for the purpose. They receive their loads from a dumper and then pass *via* two routes to the pier deck. One route leads up to a long incline to the pier deck and is accomplished with the aid of a barney operated by cable. The second route leads to the foot of the elevator framework. Here the loaded car passes to the elevator platform and is hoisted vertically a distance of about 67 feet; then runs out from the elevator to the pier deck under its own power and delivers its load wherever wanted. The special pier car is needed because it is self-cleaning, the railroad car is not. On the pier, it is necessary to dump through the bottom. The road cars would fail here, where at the dumper they do not fail because of their more nearly complete overturn.

Of course, there is no such thing as perpetual motion in the sense that power can be delivered without a corresponding receipt of power from some source. However, there is such a thing as the advantageous distribution of power. At the foot of the elevator, the loaded pier car weighs, with its load, well over 400,000 pounds.

The platform and adjuncts used to raise and lower cars add considerably to this weight. An ordinary lift of the total weight involved would require larger power units than the ones installed at Hampton Roads, where heavy counterweights lend such assistance in the hoisting operation that the power plant has less to do than is actually done. The matter is equalized, however, on the down-trip; the power plant now has work to do, since to get the platform down again, a part of the weight of the counter-weights has to be lifted. At Sewell's Point, the work for the power plant is so adjusted by means of the counterweighting that there is but little difference between an up-trip and a down-trip. The result is the permissibility of using smaller power units. Moreover, the power consumption is spread uniformly over the whole round-trip, a state of affairs that makes for economy.

LEGAL NOTICES

PATENTS

IF YOU HAVE AN INVENTION which you wish to patent you can write fully and freely to Munn & Co. for advice in regard to the best way of obtaining protection. Please send sketches or a model of your invention and a description of the device, explaining its operation.

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SCIENTIFIC AMERICAN
contains Patent Office Notes. Decisions of interest to inventors—and particulars of recently patented inventions.

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Signaling and Talking Through Space

(Continued from page 371)

distance of 3,600 miles, and to Honolulu, Hawaii, about 7,000 miles! A large battery of vacuum tubes, arranged as generators, and others arranged as modulators, were employed in these long-distance tests.

The vacuum tube, in its present form, is made in various designs, although fundamentally it consists of one or more filaments which can be heated to any degree, and two or more electrodes. The theory of what takes place within the bulb is complicated, hence must be avoided here for lack of space. However, the present vacuum tube is available as a detector of wireless signals and wireless telephone waves, as a modulator or relay, as an amplifier or builder of weak currents to powerful currents, and as a generator of alternating currents of a wide range of frequencies.

Electric Lamps Which Have Made Wireless Telephony Practical

Given a perfect amplifier and a perfect modulator, the problem of radio telephony is solved, at least theoretically, for all that is necessary is to modulate the output of an oscillating circuit and then, if necessary, amplify the modulated current to any degree in order to obtain a sufficient volume of current in the aerial for transmission through space. Or one may first generate oscillations of large power and modulate them by means of the amplified output of the telephone transmitter. That is why, with the perfected vacuum tube, wireless telephony was practically perfected overnight. It became possible to telephone from airplanes to the ground and vice versa; to telephone over land lines to a wireless station, which in turn sent out the conversation to a battleship or steamer, and to receive the answers back through the wireless station and land lines; and to telephone through space many thousands of miles. Of course, many details had to be solved. The noises of the airplane had to be contended with, by the development of special ear-pieces and helmets, as well as by special transmitters which would respond to the voice and not to the extraneous sounds. And with our Army and Navy in need of thousands of bulbs a week, the design and manufacturing methods had to be altered so as to permit of quantity production.

Like nothing else the vacuum bulb proved the greatest single contributor to wireless communication. Quite appropriately, it has been referred to as the modern Alladin's lamp.

Thanks to the sensitiveness of the vacuum tube as a wireless wave detector, and then to its amplifying properties which make it possible to build the weakest currents up to any volume without distortion, aerials for receiving purposes have begun to shrink to small proportions. Thus it has become possible to make use of exceptionally small aerials and even buried aerials. Indeed, James H. Rogers of Hyattsville, Md., has developed an interesting form of underground wireless which has been used by our Navy with excellent results. This system makes it possible for submarines to receive wireless messages over great ranges without coming up to the surface. Incidentally, this system, it is understood, practically eliminates static—which is the free electricity due to atmospheric conditions—as well as interference from undesirable stations.

Receiving Thousands of Miles with a Three-foot Wire Loop

Another recent development in wireless reception is the use of a simple loop aerial, say three to six feet in diameter, with which it is possible to receive waves from stations thousands of miles away, provided proper apparatus is employed. In fact, it is stated on good authority that within a year a loop aerial will permit an amateur to receive signals from almost all over the world. And the loop, most remarkable of all, can be used indoors. However, for transmitting long distances the elevated

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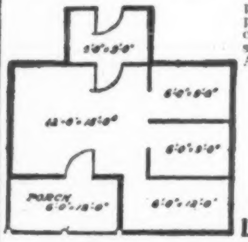

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aerials are not going to disappear so soon, because it is mostly the reception of messages which lends itself to buried aerials and loops. What makes the loop so efficient is its positioning in the proper plane, so as to intercept the waves to the best advantage. The loop is employed on certain Army and Navy planes for the purpose of receiving direction signals. Thus it becomes possible for the pilot, by maneuvering about until he receives the loudest signals from a ground station, to locate the direction of the station. The loop, in that case, is generally incorporated in one of the planes.

How the United States Government kept in touch with our forces and diplomats overseas is one of the most interesting stories of modern radio communication. Indeed, early in the war information was received that the Germans were making extensive preparations for the cutting of the cables for the purpose of interrupting our communication with Europe; and this fact, more than any other, gave a tremendous impetus to wireless. As it was, three cables were actually interrupted, and excellent evidence is at hand that enemy influences were responsible. Wireless telegraphy was called upon to assume only part of the burden of cable traffic, which often aggregated 200,000 words in each direction per day, and at no time was the radio service worked to full capacity.

It is from a little room in the new Navy Building at Washington, D. C., that all our trans-Atlantic radio traffic is handled. The Navy operates four powerful stations—Annapolis, Md., New Brunswick, N. J., Sayville, L. I., and Tuckerton, N. J. The Annapolis station, with its four 600-foot towers, is believed to be the most powerful station in the world. It has a 350-kilowatt transmitter. The New Brunswick, Tuckerton, and Sayville stations are rated at 200 kilowatts each. All these stations are operated from Washington, by means of land lines. Whereas other governments operate their wireless stations at the very base of the lofty powers, we have gone a step ahead of them by centralizing our stations in our Capital.

There are four tables in the trans-Atlantic room, each table connecting with one of the four stations. On each table there are two ordinary telegraph keys, one of which is directly connected by heavy land cable with the transmitter at its respective station. The operator, sitting at Washington, operates the transmitter at the wireless station, without delay and without the services of another operator. The other key serves to telegraph any instructions as to the manipulation of the transmitting equipment.

Operating a Wireless Station from a Distant Point

Each operator wears a pair of telephone receivers which enables him to hear the signals from the transmitting station which he is operating. The receiving aerial is erected on the roof of the Navy Building at Washington, carefully attuned to the wireless stations to which it belongs. One table operates the New Brunswick station, which may be working with the steamer "George Washington." The second operates the Annapolis station, which may be working with Lyons, in France. Ordinarily, the New Brunswick station also operates with Lyons, insuring two traffic lines instead of one. The third table operates Sayville, which may be working with the station on top of Admiral Sims's office in London. Tuckerton is operated from the fourth table, and may be used for keeping in touch with Rome or other European capitals and centers. Most important of all, the four stations may be working at once, yet there is no interference because of the perfect syntony or tune of the transmitters and receivers.

In order to speed up traffic, especially in the case of press dispatches and similar voluminous matter, the radio messages are sent by means of perforated paper tape. An operator, sitting before a machine which resembles nothing so much as a typewriter, perforates a paper tape by manipulating a keyboard. The paper tape, in turn, can be reeled through an automatic sending machine at the rate of 100 words per minute, as compared with the usual 25 words a minute of hand sending. At the receiving end, a special photographic form of recorder, which employs the string galvanometer and a beam of light principle, records the high speed messages on a tape which can be decoded in the operator's own good time.

It has been said of aviation that the war gave it at least a 10-year gain in development and application. But in this respect aviation is not unique; for, to all appearances, American radio communication has made an equal advance as a result of serving its country and the Allied cause.

Admiral Sims in the Team-Work for Victory

(Continued from page 374)

As to our forces serving under foreign commands, one has but to stop and think of the tables reversed, with foreign navies coming over to operate from our ports, and with our Navy from our shores, and imagine our Navy relatively bigger than the other navies, as our's was relatively smaller in this war. Wherever our ships were allocated, they found already existing a large number of ships with large bases and supply systems and complicated extensive and expansive communication systems built up to support them.

It would have been nothing but ridiculous to have insisted upon any of our officers relieving the senior foreign officers in command of these stations from which our ships were to operate, commanders who had been carrying on their duties for three previous years of the war. As a matter of fact, Admiral Sims never questioned as to who was to command, that is, whether a foreigner or an American; he merely assumed that the senior man on the spot who should naturally, owing to experience, be the best man, would, of course, command our ships when they joined his ships.

British Munitions

(Continued from page 375)

1918, there were 198 of these operated by the Ministry of Munitions. First were the four Royal Factories, engaged in producing ordnance, gunpowder, small arms and aircraft. Then there were 46 explosive and propellant factories, 22 filling factories where women's hands filled shells to shoot Huns, 13 projectile factories, 40 shell factories, nine ammunition component factories, seven tool and gage factories, 28 box factories and saw mills, eight aircraft factories, four steel works and rolling mills, 10 ordnance factories, three small arms ammunition factories and four miscellaneous factories.

These plants, many of them starting small, often grew to tremendous proportions. In the great arsenal at Woolwich a rapid growth took place, typical of all. To it, England is indebted for almost all kinds of munitions and for the performance of work of the most highly-specialized and skilled character including the preparation of drawings, specifications and the working out of the details of the new types of both guns and shells in which such great advances were made during the past year. In August, 1914, the staff consisted of 10,866 persons; in 1918 it amounted to more than 75,000. The number of women employed in 1914 was 125; at the beginning of 1918, 25,000 women worked there.

To go into the need of a certain number of government owned and operated factories, in addition to the thousands of government controlled factories, would be to extend indefinitely an article which already promises to be too long. But economy was a driving factor if not always the only factor, in the decision to establish and operate a Ministry of Munitions factory. As an example of economy, a group of T.N.T. factories which have been operating for the longest period required a capital expenditure of $7,500,000, but provided a capacity which has already produced ex-

(Continued on page 386)

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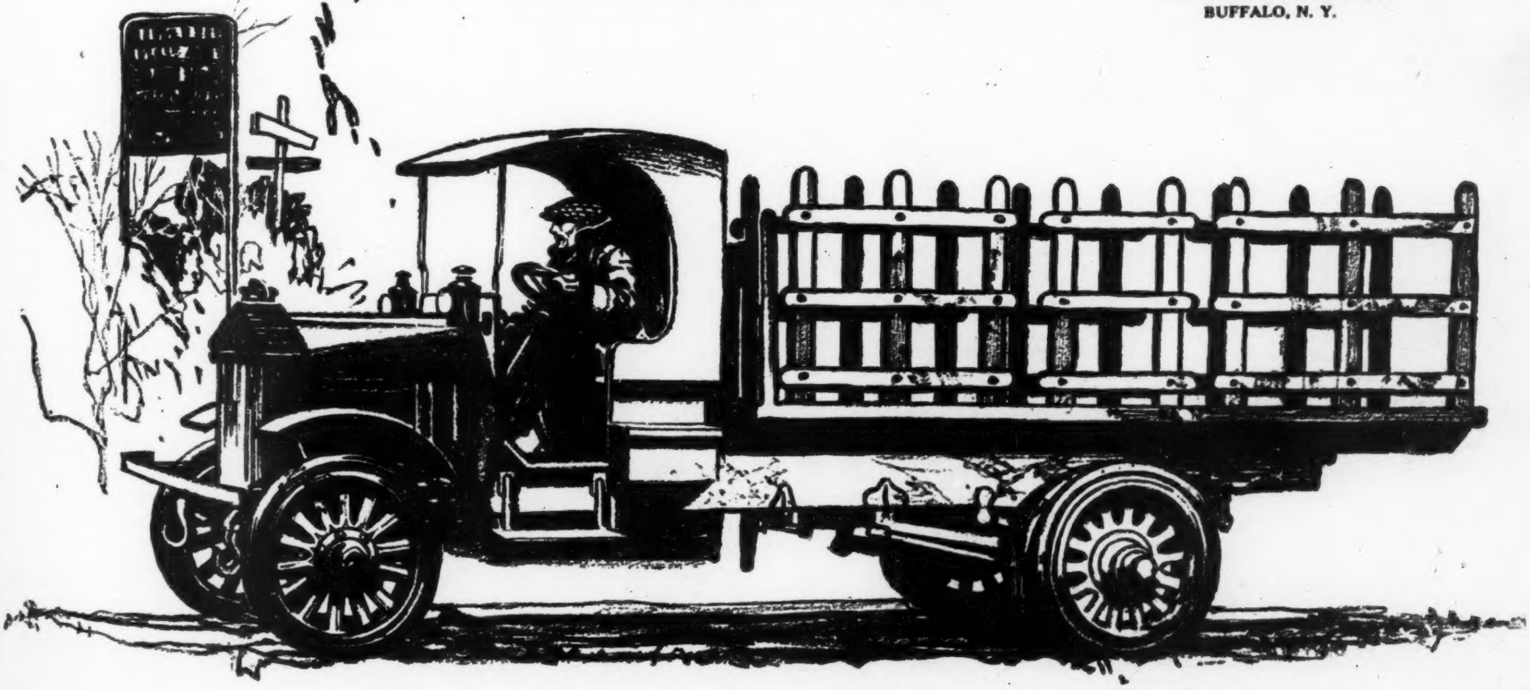

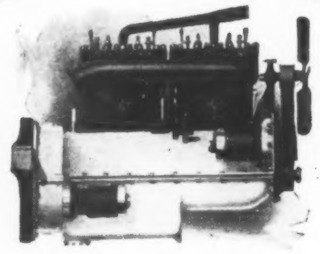

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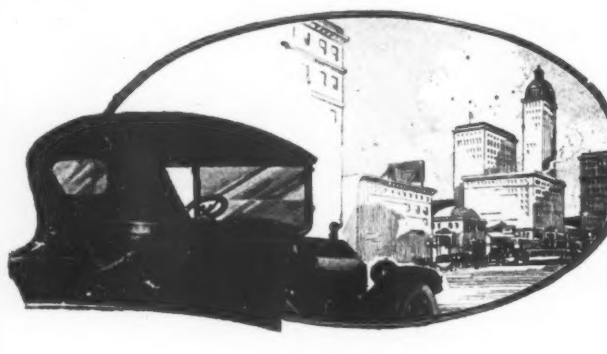

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DU PONT

British Munitions

(*Continued from page 384*)

plosives at a cost of $17,500,000 which, at the contract prices being paid when the factory was under construction, would have cost England $35,000,000.

The cost of production of T.N.T. at Queensferry in 1917 exclusive of interest and amortization was about 17 cents per pound. The cost in the market when this factory was started was about 43 cents per pound.

Because the war is not yet ended, the Ministry of Munitions is giving out few if any figures on the amounts of anything supplied. But percentages are of little use to the enemy and they are available to some extent. For instance the production of airplanes by the end of the war had grown to over 700 per cent of what it was at the beginning. Airplane factories turned out in a week at the time of the armistice more planes than the whole country produced in the entire year of 1914, in a month more planes than the entire production of 1915, and in three months more planes than the entire production of 1916.

The machine-gun industry increased by 3,700 per cent. Eighteen-pound shells were turned out to the tune of 900 per cent at the armistice against one per cent in August, 1914; and so the story runs.

The trench warfare supply department handled an enormous variety of supplies from fireworks and grenades to the heaviest form of bombs, also helmets, shields, specialized chemical apparatus, trench mortars and their ammunition. This department supplied 1,500,000 steel helmets in one period of six months. In December, 1916, the tonnage requirements amounted to 7,648 tons, while in June, 1917, they reached 17,963 tons.

In March, 1917, the high explosive output was four times greater than in March, 1916, and 28 times the output of March, 1915. During the war the optical output of England, which country had previously depended, as had we, largely upon Germany for glass and mathematical instruments had increased by 2,000 per cent.

It has all been done at a tremendous cost, of course, both in money and in labor. The national munitions factories cost over $330,000,000 to erect and get started. Grants of more than $80,000,000 have been made to private firms, besides a similar sum in buildings, tools, plants, etc., handed over to private firms by the Ministry, that they might work the faster and the better. National arsenals increased from three to more than 200—of what use to continue isolated figures? England jumped into the war with both feet and when she set herself to make her armies the best equipped and the most efficiently provided in the field she did it whole-heartedly, single-heartedly, absolutely regardless of any other consideration. We in the United States are proud to think of what we did in a year, but sending two million men abroad from a population of 110,000,000, big feat as it is, does not bulk so large against putting an army of 7,000,000 in the field from a population of 40 or 50 million, and in addition to supplying them, supplying allies, including United States troops, with much of what they fired and much of what they fired from!

This may not be the place to speak of the women's part in munitions work—it properly belongs, doubtless, in a story on labor, but it should never be forgotten that at the time the armistice was signed *nine-tenths of the total shell output was the work of women who prior to the war never even saw a belt, a lathe, a tool or wore overalls.*

It is with some timidity that the matter of labor statistics in munitions work are approached. They differ so—they so contradict each other! One department says roundly that three million people are employed in making munitions. Another says it is two millions. Both are probably right, the larger figure including all civilian workers on war work, the smaller referring

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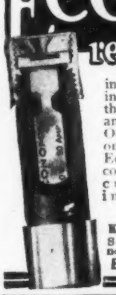

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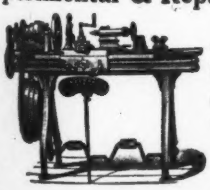

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only to those supplies governmentally classed as munitions, and perhaps excluding Admiralty laborers. However, there is one set of figures which comes fresh from the Ministry of Munitions which ought to be authentic, and which, because it illustrates so wonderfully the growth of the munitions industry, one is tempted to give in full and in tabular form. Only no one reads tables of figures, so the table is omitted and the attempt made here to force the reader to absorb the story the numbers tell, by, as it were, sneaking them past his vigilance!

In the beginning of the second quarter of the year 1915, which means of course, six months after war was declared, the government here had employed in both governmental and private establishments in the metal, chemical, explosives and rubber trades, but not including the Admiralty workers, not quite 600,000 people, in about the proportions of eight men to one woman. In six months more, or by October, 1915, the total was 1,003,000. but the women had almost doubled in numbers. By the end of the following year there were 1,648,000 of these munitions workers, of which 848,000 were women—more than six times as many as were at work 18 months previously. And on October 1st, 1918, just before the armistice, supplies were turned out by 2,049,000 munitions workers of which more than a third were women—1,319,000 men and 730,000 women. Please note carefully that these are not figures of either women or men *civilian* workers in England—but of women and men *munitions* workers, exclusive of the thousands on trains, trams, farms and in civilian factories. The Ministry of Munitions confesses to have no very exact figures for 1914, but estimates that before the war about 50,000 men, and practically no women, did munitions work.

Great Britain will not be entirely without material reward. No one here thinks any sacrifice has been too great, any hardship worth mentioning, any dislocation of tradition too severe to undergo, now that Germany has been definitely brought to her knees and the war won. One hears no complaint, no moaning, no expression of regret that the "right little, tight little island" has been turned wrongside out and upside down socially, politically, economically, to "get on with the war" to "carry on" to the successful accomplishment. But when at last the war dislocation is reset, England may well look to some of the fruits of her munitions work with a feeling that at least there is no great loss without some compensatory small gain. For instance, as a direct result of munitions campaign, Great Britain can now claim first place in the electrical industry, over Germany and Austria. This she can do on many accounts, but on none more than on the production of mica. India produces 50 per cent, Canada 15 per cent and what was German East Africa 10 per cent of the world's supply. And now Indian mica can be exported from that country only to London!

England now produces all the high speed tungsten steel she needs. In pre-war days the United Kingdom produced no ferrochrome, needed for certain steels. Now one factory, driven by waste gas from coke ovens in a quite American-utilization-of-waste-product manner, produces enough to meet all the requirements of the kingdom. In pre-war days the United Kingdom used some 240,000 tons of spelter annually, of which 77 per cent was imported from Germany, Belgium and Holland. The Australian concentrates are now, of course, diverted from Germany to the United Kingdom, with the result that the zinc smelters are trebling in size. Prior to 1914, 30,000 tons of potash were imported annually, principally from the Stassfurt mines. But England discovered she had 50,000 tons going to waste in dust and fumes from blast furnaces, and nearly 20,000 tons annually are now being recovered and there is more on the way. England has learned a great many things

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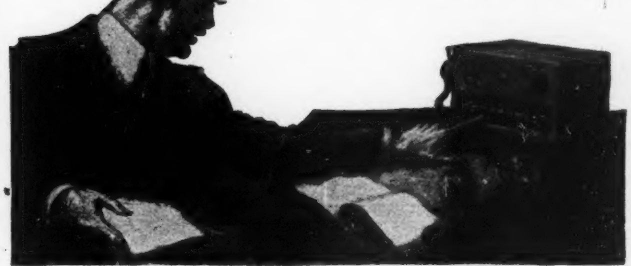

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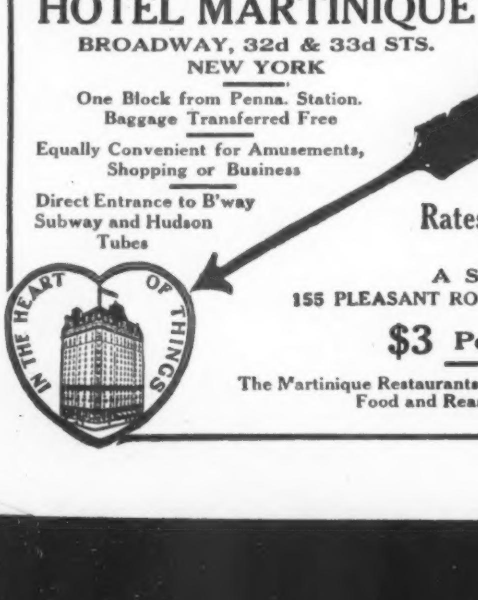

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about factory work she never knew, or if she knew, would not use, before. The mechanical conveyor, the electric truck and trailer, the shop sled, the standardized output, the health and condition inspection for workers, are cases in point—not that she did not know of them in pre-war days, but that they were not universal—as they now are.

One feels totally inadequate to understand, let alone describe, a munitions program which has been as immense at home as the armies in the field which demanded it have been immense abroad. But one looks at a figure here, a picture there, a worker in overalls trundling a truck of shells who should be trundling a baby—one sees old men, crippled men, men in ill health, all with a smile, making shells and guns—one sees workmen to whom the trade union has been but a step below the church in veneration, working hours the trade union never sanctioned, side by side with "dilutees" and girls and doing it willingly to "get on with the war"—one sees huge factories built where were fields and parks and waste spaces, enormous plants and the homes for the workers constructed almost overnight, and one sweeps one's hat from one's head in hearty admiration and a little awe—even if he comes from a country where such things are commonly done as a part of the romance of industry—at the spirit, the courage and the single-mindedness which "carried on" such a successful and such a magnificent industrial effort.

Substitutes for Belting in Germany

LACK of leather for driving-belts and of oil for lubrication caused the Germans to invent curious substitutes, according to the War Trade Intelligence Department of Great Britain, which has been investigating the enemy's secrets. Belts were found that had been made of paper tissue or hair yarn.

If very strong yarn was used in chain-stitch only one layer was required, whereas weaker yarn had to be twisted together in several layers. It was advisable to edge the belt with leather or tin, otherwise the edges wore away rapidly.

Driving belts made of tissues sewed together or rolled inside one another were exceedingly resistant and stronger in the edges. The friction was slight and they could be mended easily. This kind was made mostly of spun flax, hemp, or paper yarn. Those of the last kind, which were plaited or knitted, had no transversal threads which serve to make the edges strong.

Cellulose material was used for medium-sized machinery, but care had to be taken in putting them on, and not to pull them too tight for they could not resist much tension. The yarn belts were also woven or knitted in tube form, which was flattened out afterward and sewed together; cotton or paper was used mostly in such cases. They proved very useful substitutes for leather.

The Textilose-Epata belts consisted of separately twisted jute or cotton threads. They proved to have great flexibility and elasticity, each fiber bore a part of the tension, and there was no giving away at the edges.

The former rubber and balata belts have given place to ones of substitute rubber. The newer material proved to resist melting when heat was caused by friction. The main drawback was that it could not stand much tension.

At the Leipzic exhibition a new belt was shown comprising the following: The chain made of horse-hair or wire; the cross thread of old cotton, typha, or peat fiber, the belt so formed being thickened with tar. These driving belts were only supplied retail in exchange for a form testifying to the need of them.

In a wool weaving works, it was reported, the thick canvas driving belts, which substituted leather ones, had been found satisfactory since they did not suffer any more breakages than leather. However, they could not be repaired so often.

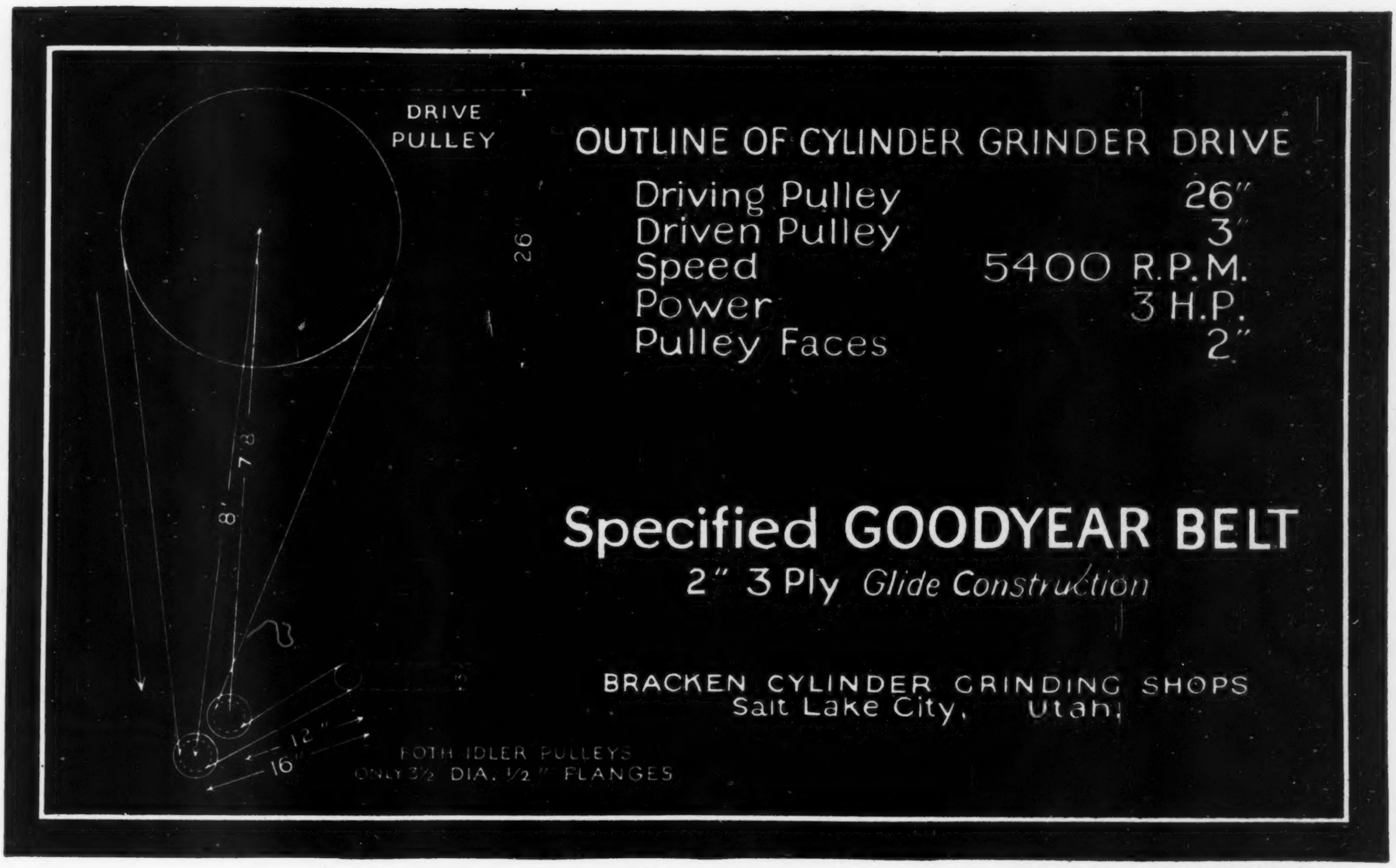
NEW BOOKS, ETC.

MODEL MAKING. Including Workshop Practice, Design and Construction of Models. Edited by Raymond Francis Yates, Editor of *Everyday Engineering Magazine*. New York: Scientific American Publishing Co., 1919. 8vo.; 400 pp.; 303 engravings. Price, $3.

The creation of true working models is not toy-making, it is engineering in miniature; but the practical knowledge this pursuit confers is far from being knowledge in miniature. It is impossible to construct a model locomotive, for example, without knowing every detail of the physiology and functions of a real locomotive; successful construction demands a familiarity with steam engineering, with blueprint reading, and with the art of the mechanic. It is the best conceivable training for big work, training that the most conscientious transfer of ideas to drawing paper cannot approach in educative value. Every conceivable mechanical movement may be employed, and inventors find spare time spent in reproductive work by no means time lost. Such work should be more widely used in manual training classes and technical schools as an important means toward the education of the embryo engineer. The maker of actual working models is often of the greatest service to his country, and men prominent in walks of life remote from the mechanical field have broadened their minds and strengthened their faculties by engaging in this fascinating work in their leisure hours, finding at the same time rest, recuperation, and a deeper interest in life. "Model Making," the only book devoted to the real art of engineering in miniature, sets a standard that will be hard indeed to surpass. In language that may readily be understood by the merest amateur, it progresses from first principles and simple combinations to instructions, short-cuts, and apparatus that only the experienced can fully take advantage of, and that will be new to most workers in metal. The directions and drawings are complete to the finest detail and there are help and inspiratio at the turning of every page. The first part of the volume will be a revelation to the inexperienced. It depicts the ideal workshop, shows how the man of limited resources may install it in the cellar or the attic, and treats of its lighting, heating, ventilation, power-driven machinery, and tool equipment. It familiarizes the student with lathes and lathe work, drills and drilling, soft and hard soldering, hardening and tempering, and the use of abrasives. How many mechanics can make their own patterns? The chapter on pattern making is a complete treatise in itself, while that on electro-plating describes a process of the greatest importance to the preservation and appearance of the finished work, and one that is by no means as costly or intricate as is usually supposed. The second part of the volume is devoted to the actual construction of numerous models, a chapter to each. Here is found a mine of suggestion for the model maker, from the simple slide crank steam engine and the single cylinder marine engine to the caterpillar tank and the siege gun. Among other interesting pieces of mechanism are a flash steam plant for large model airplanes, a steam turbine, various boilers and their fittings, a record-breaking hydroplane with a speed in excess of thirty miles an hour, a lake freighter, a submarine with radio control, an electric derrick crane, a gas engine, steam and electric locomotives, and a gyroscope railroad. Illustrations of a high order of merit make these descriptions complete and every feature plain. Many pages of detail drawings are given, important parts or assembled parts are shown from one or more viewpoints, and always there is a photographic reproduction of the finished machine. Some of the ablest model makers of this country and England divulge their experience and methods in this satisfying manual. The helpfulness, skill and clarity so manifest in the new work to even a casual inspection will raise up for it a host of friends, and among the few choice volumes upon which the earnest craftsman depends for unfailing aid and inspiration it will soon make itself indispensable.

THE BLUEJACKET'S MANUAL. United States Navy. By Lieut. Norman R. Van der Veer, U. S. N. New York: The Sherwood Company, 1918. 12mo.; 807 pp.; illustrated. Price, $1.25.

Now in its sixth edition, this excellent manual gives exactly the knowledge that should be in the possession of every bluejacket. Part I addresses itself to every man aboard ship, Part II to seamen of the second class, Part III to the higher ratings of seamen branch, Part IV to chief petty officers, and Part V to men of special ratings. Every phase of life, discipline and training is minutely dealt with, from athletics to ordnance and gunnery. The wealth of detail would be bewildering, except for its careful arrangement and the facility offered by the classified index. What the service offers, and how to make the best of opportunities, is distinctly explained.



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High Speed Grinding—and the G.T.M.

Harry L. Bracken in Salt Lake City used to have what he called a champion belt eater. It was a high-speed cylinder grinder with an old style drive. It cost a hundred dollars a year to keep that one little machine belted. The highest priced belts lasted only six or seven weeks—some only two weeks. As soon as their joints went bad, the belts were practically done; for the mile-a-minute speed of that drive and the reverse over an idler, made durable repairs almost impossible. Occasionally the joints did hold and those were the times when six or seven weeks' service was obtained.

One day our Mr. Le Masters, a G. T. M.—Goodyear Technical Man—called and explained to Mr. Bracken the Goodyear idea of selling belts to meet conditions and not as a hardware man sells nails. He explained the Goodyear Plan of accurate diagnosis of all drive conditions before prescribing the proper Goodyear Belt. Mr. Bracken listened, felt he couldn't possibly do any worse than he was doing, and took Mr. Le Masters to his belt-devouring cylinder grinder.

The G. T. M. studied the drive, measured the pulleys, measured the speed—and then studied the pulley faces carefully. He found that they were the kind that Glide Belting is especially designed to serve—so all that remained of his problem was the length, the width and the number of plies. He prescribed these to fit the conditions and Mr. Bracken signed the order for a Goodyear Glide Belt, *costing much less* than the kind he had been using. The belt came and, of course, didn't have to wait long. It was installed November 18th. It has outlasted every other belt and at the time this advertisement goes to press, it is still running

The G. T. M.'s service and Goodyear Belting have done more than cut belting costs. The grinder runs more quietly, does better work, is much easier on bearings, and according to Mr. Bracken is like a different machine. He has since had the proper Goodyear Belts installed on all grinding spindles.

If you have a belt-devouring drive that is eating too many dollars, ask a G. T. M. to call. He'll do it without charge when next he is in your vicinity. There are many of them—all trained in the Goodyear Technical School—all with experience in plants similar to yours—all selling belts to meet conditions and not as a grocer sells sugar. The G. T. M.'s services are free simply because the savings they effect for purchasers are so considerable that a gratifying volume of business from the plants served is certain to come to us within a few years.

THE GOODYEAR TIRE & RUBBER COMPANY, AKRON, OHIO

BELTING · PACKING HOSE · VALVES

GOODYEAR

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Building GMC Truck Confidence

The man who owns a GMC Motor Truck may well look upon it with the same degree of confidence he once placed in its predecessor, the horse, his faithful friend.

Whether it be a single GMC Truck or a fleet, the owner finds untold satisfaction in his confidence that his work will be well done.

During the years since GMC Trucks were put on the market there has grown up among GMC owners everywhere just such a feeling.

There is a good reason for it. GMC Trucks from the very first were built to be inherently good—Good for their own sake.

No GMC Truck was ever built to meet a price.

The GMC ideal has been to build the best truck possible in a particular size, for a particular kind of work.

That is why, as a result of proof of performance, the reputation of GMC Trucks for reliability and plain honest quality is rapidly growing.

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